

AN EMPIRICAL INVESTIGATION

OF CREATIVITY

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ABSTRACT

Creativity was empirically investigated in a series of three multivariate studies. The initial study was exploratory, examining interrelationships among a range of creative person, process and product variables which have been identified in the literature. Findings indicated complex interrelationships between these variables and their influence on creative performance which varied across mode, subabilities, and testing conditions of performance tasks. A conceptual scheme for descriptive, assessment and predictive purposes was proposed, focusing on identification of necessary creative abilities, optimizing conditions for measurement and influences on utilization of abilities, the sufficient condition for creative performance. Experiment 2 examined a specific creative process, intuitive problem-solving. The effect of an incubatory period, involvement of subliminally perceived information, situation-specific expectations of self-efficacy on the nature of intuitive solutions were evaluated. Experimental results provided evidence for the phenomenon of intuition and extended commonly associated properties to include the subjective experience of effortlessness. The ability to intuit and its subjective quality were found to be influenced by personality differences and attitudinal factors. In Experiment 3, the validity and predictive utility of previously utilized creativity measures were re-examined in an independent sample for socially relevant criteria of performance. In addition, two training programs were developed and instituted, a visual imagery and a verbally presented creativity training program. These were

compared for their direct and indirect effects on utilization of cognitive abilities and performance level. Training effects were found to interact with hemispheric preference as measured by conjugate lateral eye movements, suggesting that training in nonpreferred processing modes enhanced performance across a range of contexts. Personality characteristics associated with hemispheric bias validated results from Experiment 2. A bidirectional pattern in eye movements was associated with a more adaptive and well-adjusted personality style than unidirectional consistency. Based on a synthesis of the empirical findings, a three level descriptive model of creativity is proposed and theoretical implications discussed. The empirical results and model development were considered to highlight the multidimensional and interactive, dynamic nature of creativity and point to the importance of future empirical and theoretical research recognizing these issues.

CHAPTER I

1. OVERVIEW OF CREATIVITY THEORIES

To review the history of psychological theories of creativity demands first a choice of which taxonomy to use. Selecting a temporal criterion is tempting but rather than leading to a distinct developmental trend or a progressive accumulation of knowledge, this approach creates a maze in which it is difficult to gain a sense of direction.

The classification systems which have commonly been used in reviews on the subject will be outlined, in order to demonstrate that a choice can only be somewhat arbitrary and that each system on its own is deficient. The purpose here is not to review all theories of creativity but to provide an overview and to set a context for the range of perspectives taken in the empirical literature on creativity. Most reviews begin with the theories which emerged in the middle of the 20th century. Prior to this, relevant but peripheral research was being reported under headings such as imagination or productive thinking.

Busse & Mansfield (1980) classify theories of creativity according to the varying psychological traditions from which they were approached. The most elaborate and plenary of the creativity theories arose from the psychoanalytic tradition. Most notable are Kris (1952) who proposed that essential to creative thinking is temporary abandonment of logical, rational thought and regression to a preconscious level of thinking, and Kubie (1958) who concurred that the preconscious was the source of creative

thought. Kubie was concerned more with the inhibiting effect of neurotic behaviour than with the phases of the creative process, emphasized by Kris.

Busse & Mansfield (1980) include the Gestalt theories in their classification system, which do not refer to creativity "per se" but deal with principles of problem-solving. Associationist theories describe creativity as resulting from the number and unusualness of associations. These theories have been particularly fertile for the development of measurement instruments (see section on Measurement of Creativity). Associationist ideas have infiltrated much of the work on creativity although the concepts tend to be severed from the original theoretical base.

Creativity is described in humanistic theories as a necessary expression of the self-actualized person (Rogers, 1954; Maslow, 1971) and a potential of all. Cognitive-developmental theories, as categorized by Busse & Mansfield (1980) are represented most clearly by Feldman's work which posited creativity as a special case of more general intellectual development, including Piagetian stages. A category is assigned to composite theories, by these reviewers, which combine elements from other traditions. They cite as one example Koestler's theory of bisociation (1964, 1978) which combines associationism and concepts from psychoanalysis. Bisociation is the association of two previously independent ideational matrices and requires preconscious processes.

Torrance (1979a) describes the history of creativity theory in terms of a continuum defined by the level of rationality and adaptivity of cognitive processes. In early theories creativity was treated as a regressive, lower than rational/logical process (e.g. Kris). Kubie progressed to the idea of healthy and adaptive preconscious processes rather than regressive. A number of theorists in recent years have introduced the concept of suprarational or translogical processes to explain creativity. Arieti (1976) described it as the "magic synthesis" i.e. the binding together of primitive, irrational forces of the unconscious with logical, rational and cognitive mechanisms of the conscious mind. May (1975) portrays creative processes as "suprarational", bringing intellectual, volitional and emotional functions into play together. Essentially a humanistic perspective, creativity is considered by May to represent the highest degree of emotional health and actualization. Rothenberg's theory of Janusian and Homospatial thinking (1973a,b, 1976, 1978, 1979) describes these modes of cognition as transcending logic and ordinary rational processes. Finally, Torrance himself has moved from a fairly restricted associationist approach in his early days of divergent thinking test development, to a theoretical position incorporating "further reaches of creative potential", abilities that go beyond rational thinking (Torrance & Hall, 1980). His description of consciousness transcending the boundaries of deliberate, rational processes is reminiscent of the group of writers who ascribe creative thinking to altered states of consciousness (e.g. Krippner, 1968, 1981; Krippner, Dreistadt & Hubbard, 1972; Simon, 1977; Green & Green,

1977; Khatami, 1978), a model which remains outside many classification systems - although the dimension of state of consciousness is pertinent to much of the theoretical literature.

Rational theories of creativity encompass those postulating a two-stage conception of the creative process, such as Osborn's ideation/evaluation theory, Hitt's (1965) original thinking/logical reasoning conceptualization and Stein's hypothesis formation/hypothesis testing theory (McMullan, 1977). In addition, recent authors such as Perkins (1981) and Hofstadter (1982) are firm adherents of logical reasoning processes in creativity. Hofstadter (1982) discusses the possibility of mechanizing inspiration. Perkins (1981) explains insight and intuition as the result of normal cognitive processes such as realizing or recognizing.

"There is no such thing as creative thinking, there is only thinking; but thinking occurs so seldom that when it does we call it creative."

Francis Cartier.

The dimension of mental health - psychopathology underlies many of the theories of creativity previously mentioned (see Storr, 1972 for an in-depth discussion of this topic) and is implicit in the categorization of motivational theories. These are many and varied, but as a sample:

- creativity serves as a defense

- creativity reflects a compulsive need to order. and control
- creativity provides expression for wish-fulfilling fantasies of the dissatisfied
- creative activity is an attempt to avoid or overcome feelings of alienation
- creativity results from extrinsic motivation from factors such as fame and wealth
- creativity results from intrinsic motives such as enjoyment and pleasure in utilizing skills
- creativity results from an inherent need for novelty and play

(MacKinnon, 1978)

One reason for the diversity of theories and of taxonomical systems of theories, lies in the many meanings of creativity. Definitions are seldom stated, almost purposely avoided in the theoretical literature and usually must be deduced. For some, creativity denotes an ability or group of abilities to bring something new into existence and stems from personal characteristics. For others it denotes a process, or processes by which novel and valuable products are developed. Probably the best known theory of creativity illustrates this particular definition most aptly, although it does not easily fit into any of the previously outlined classification schemes. Wallas (1926) formulated the renowned process model involving four stages: preparation, incubation, illumination and verification. This is a sequential model of distinct phases, incorporating diverse concepts of state of consciousness, degree of rationality of cognitive processes and attitudinal set. Virtually a

paradigm for creativity for many years, it is now more of historic interest than heuristic.

For others, creativity is not the process but the product, which is defined by such criteria as novelty, adaptability, elegance, aesthetic quality, transcendence, transformation, social impact. Definitions of creative products range from tangible to intangible; even the individual is seen as the creative product by some, particularly those of a humanistic orientation.

Definitions of creativity range all the way from simple problem-solving to conceiving it as the full realization and expression of all an individual's unique potentialities, from a neurotic, primitive, regressive phenomenon to the sublime. MacKinnon (1978) concludes that there is no single best definition and that creativity carries all these meanings and more, a truly multifaceted phenomenon. He suggests we think of creativity "not as a theoretical construct to be precisely defined, but rather as a rubric or a chapter heading under which a number of related concerns quite naturally fall" (p.47). From this viewpoint there are at least four major aspects: the creative process, the creative product, the creative person and the creative situation.

Although these aspects can be used in classifying the theoretical literature on creativity, to a certain degree, they are more applicable in describing the empirical literature. This has tended to sidestep the problems of definition and to be concerned with studies which commonly

approach the investigation of creativity from just one of these aspects. Much of the investigative work can be seen to derive from a particular theoretical orientation although it is often proffered as atheoretical.

2. NATURE AND SCOPE OF THE INVESTIGATION

"The phenomena which are conveniently accessible to empirical enquiry naturally comprise the first subject matter of a science, and in this respect psychology is no exception. For this reason, the discrete items, those associated with memory and cognitive structures, are popularly in use in psychological science, and have become the sacrosanct subject, the other remaining psychical abilities and their attributes being ignored or outright tabooed. These current models study the constitution of mental representation by examining what discrete items underlie the representation itself. This type of research, motivated by linear sequential thinking, is obviously wanting in the proper ethos, and an alternative approach which studies the total order of structure, the way it is postured to exist and to act, is needed in psychology."

Ahsen, 1982.

Although Ahsen was not referring specifically to creativity, there surely can be no area of human experience which would be more accurately identified. Although the present thesis does not purport to ascend to the lofty heights of scientific enquiry proposed, with which the writer concurs absolutely, it does represent an attempt to progress somewhat in this direction. This is an empirical

investigation, essentially atheoretical or multi-theoretical which, conceptually, is intended to strike a sort of medial position between the simplistic, plenary structure of early theories of creativity and the recent tendency to ignore the dynamics and gestalt of creative behavior by focusing solely on specific elements. Each of these perspectives is necessary in contributing to the understanding of such a complex, multifaceted phenomenon as creativity.

To this end, multivariate experimental designs have been used to allow flexibility in focus and analysis. The initial experiment is exploratory, examining interrelationships among factors previously found to be associated with creativity and implications from the literature. Hypotheses prompting the design of following experiments developed predominantly from the initial results but also stemmed from increased familiarity with the literature. Consequently, the overall organization of the investigation is not strictly sequential. Exploratory, descriptive and predictive goals are represented at various stages.

An overriding aim has been to assist in the demolition of the "mythology of genius". Much of the theoretical and experimental literature has applied specifically to individuals already achieving creatively in their lives. It was considered necessary that the factors associated with creative behaviour and their interrelationships, be validated in subject samples which included a range in productivity. This goal is exigent particularly with respect to creativity measures, the

utility of which surely depends on identification of creative potential.

The diversity in experimental design, selection of variables and methods of analyses may be seen to be a shortcoming in this thesis and does impose limitations on conclusions and generalization. However, the main thrust was not towards conclusive ends but towards beginnings in understanding, to generate the right questions rather than answer the wrong ones.

CHAPTER II

REVIEW OF THE EMPIRICAL LITERATURE

1. PERSONALITY CHARACTERISTICS

Stereotypes of the creative person persist among the lay population as well as some of the psychological profession, despite a 30 year history of research into the creative personality. The common stereotypes picture the highly creative person "as a genius with an I.Q. far above average, an eccentric not only in thinking but in appearance, dress and behaviour, a bohemian, an egghead, a longhair. According to these unsupported stereotypes, he was not only introverted but a true neurotic, withdrawn from society, inept in his relations with others, totally unable to carry on a conversation with others less gifted than himself. Still others held that the creative person might be profound but that his intelligence was highly one-sided, in a rather narrow channel, and that he was emotionally unstable. Indeed, one of the most commonly held of these images was that he lived just this side of madness." (p.178, MacKinnon, 1978).

The empirical literature on personality characteristics associated with creativity is typified by two features; studies have tended to use as subjects those individuals who have demonstrated creative achievements, often eminent, and generally male. There is some limited evidence that these variables are not highly relevant to the personality findings. Amos (1978) found little difference between established and less-established creative artists and between males and females. However, the field

specificity of this one study, and the dearth of additional work focusing on these variables necessitates cautious generalization from the personality literature.

A rich fund of knowledge on the creative personality has accrued from the work carried out at the Institute of Personality Assessment and Research (IPAR) established in 1949 at the University of California. Here creative individuals, including writers, architects, researchers in the physical sciences, engineering and mathematics, have been studied at the Institute over periods of several days, with a range of idiographic and nomothetic assessment techniques. For a detailed description of assessment methods and results from specific subject groups, the reader is referred to MacKinnon's (1978) book "In Search of Human Effectiveness". MacKinnon comments that surprising consistencies have emerged in personality characteristics from the studies at the Institute. However he cautions that the fields of creative endeavour they investigated were very similar to each other. Differences were also apparent, for example between scientists of different kinds and between scientists and artists.

A brief and selective summary of the most frequent and consistent characteristics found to be associated with creative achievers, follows. With respect to cognitive style, creative achievers are cognitively flexible, capable of reorganizing and restructuring problems so all possibilities can be considered. They tend to be concerned with and able to perceive deeper meanings and implications rather than focusing on small details or facts for their own

sake. Although a holistic style is preferred, these individuals are able to function at a Gestalt level or at an analytic, elemental level. They are intelligent, curious, stimulated by ideas as well as possessing critical judgement or insight. Creative individuals are percipient of both outer world and inner experiences.

Emotional reactivity, eagerness to become committed, persistence and self-awareness were found to be characteristic of subjects, as well as an aesthetic sensitivity. A degree of dissatisfaction or what poets have called "divine discontent" appears to be common to the creative process. Possessing a strong sense of independence and autonomy, creative subjects did not appear to be bound by conventions. However, these features tend to be revealed in their creative striving rather than in a social context. In fact, these individuals were found to be genuinely dependable and responsible people although not necessarily sociable or participative. They hold high aspirations for themselves, have a strong sense of personal identity and behave in an ethically consistent manner.

The subjects studied were very candid in their self-description. Adjectives most frequently used in self descriptions, especially by creative architects, were: poised, dominant, achieving of social status, spontaneous, self-confident, intelligent, outspoken, not especially sociable or participative.

Although the research perspective taken in these studies was intra-field rather than a field vs. generality

approach, Barron & Harrington (1981) reviewed diverse studies on this topic and found this fairly stable set of core characteristics emerged in the constellation of results.

The consistency of recent empirical findings with early, less objective studies of creative personalities (e.g. Terman, 1947; Roe, 1952) is quite surprising considering the variation in psychological orientation, cultural context, sample characteristics, assessment methods and research design, as well as the state of existing literature in this area. Taylor & Barron (1963) reviewed the early literature on personality characteristics of creative scientists, including Terman and Roe's work and summarized the traits as follows:

1. high degree of autonomy, self-sufficiency, self-direction
2. preference for mental manipulations involving things rather than people: somewhat detached in interpersonal relations
3. high ego strength and emotional stability
4. liking for method, precision, exactness
5. preference for such defense mechanisms as regression and isolation with affect and instinctual energies
6. high degree of personal dominance but a dislike of personality toned controversy
7. high degree of control of impulse amounting almost to overcontrol
8. liking for abstract thinking with considerable tolerance of cognitive ambiguity
9. marked independence of judgement, nonconforming

10. superior general intelligence
11. early, very broad interest in intellectual activities
12. drive towards comprehensiveness and elegance in explanation
13. special interest in the kind of "wagering" which involves pitting oneself against uncertain circumstances in which one's own effort can be the deciding factor.

Apart from differences in terminology and the focus on psychodynamic defense mechanisms the similarities to IPAR findings outweigh the differences.

Drawing on theoretical writings (e.g. Maslow, 1971; May, 1975) and empirical findings, McMullan (1976) highlights the often contradictory or paradoxical combinations of personality features associated with creative people. He proposes a model which describes the creative person's judgement, reasoning processes, memory and perception, attitude towards his object of creation, emotions, motivation and self-concept in terms of paradoxical concepts e.g. delayed-closure, detached-involvement. The model is only one method of integrating some of the apparent contradictions but more importantly McMullan offers several ways of conceptualizing these superficially paradoxical characteristics as resolved in the creative person. For example, there may be oscillation and/or sequential shifts and/or one may contribute to the other in some manner. The resolution of opposites is emerging as an important concept in recent theories of cognitive processes and cognitive styles as well

(e.g. Rothenberg 1973a,b, 1978, 1979; Torrance, 1979a; see also section on Cognitive Style and Creativity) and may prove to be a key concept in understanding creativity.

"Creativity is an arbitrary harmony, an unexpected astonishment, a habitual revelation, a familiar surprise, a generous selfishness, a vital triviality, a disciplined freedom, an intoxicating steadiness, a repeated initiation, a difficult delight, a predictable gamble, an ephemeral solidity, a unifying difference, a demanding satisfier, a miraculous expectation, an accustomed amazement."

George M. Prince (1970).

"Highly creative people are, at the same time, more masculine and more feminine, more conforming and more nonconforming, more independent and more dependent, more serious and more playful, more timid and more bold, more certain and more uncertain, and more receptive and more self-acting than their less creative peers. They successfully integrate these polar opposites into their personalities and their thinking."

E. Paul Torrance (1979a).

Recently a perspective shift is evident in the theoretical treatment of personality and creativity among several investigators who are concerned, not with individual differences between creatives and non-creatives, as much as the personality characteristics which provide the necessary

condition for creative production. Perkins (1981). and Ainsworth-Land (1982) concur that committment, involvement, and purpose are essential to direct, shape and focus the diverse processes involved in creative behaviour.

The motivation of creativity is a topic which has been somewhat lacking in the empirical literature and until the recent interest shown, the theories on motivation have tended to remain in the realm of psychoanalists (Storr, 1972).

"We cannot will to have insights. We cannot will creativity. But we can will to give ourselves to the encounter with intensity of dedication and committment. The deeper aspects of awareness are activated to the extent that the person is committed to the encounter."

Rollo May (1975).

2. COGNITIVE PROCESSES ASSOCIATED WITH CREATIVITY

The creative process has long been thought of as inherently mysterious and unanalyzable although (as the introductory discussion demonstrated) theories have abounded. Rather than subjecting early theories to empirical investigation, researchers have tended to focus on specific processes and abilities considered to contribute to creative behavior.

Stereotypically, creativity has been aligned with genius. Amongst the psychological profession the stereotype

has altered somewhat in the face of empirical enquiry. The commonly held model has been a curvilinear relationship between intelligence and creativity; presumably a certain basal level of intelligence is necessary but intelligence becomes less and less influential on creativity with movement into higher and higher levels of intelligence. However, this assumption has not been validated. Correlational coefficients between tested intelligence and creative achievement in samples of creative adults have ranged from nonsignificant negative to mildly and significantly positive (around .3) in the literature. In nonprofessional samples the relationship is often nonsignificant or weakly positive (Barron & Harrington, 1981).

A more productive and heuristically useful approach to the study of the creative process has been a focus on cognitive abilities rather than intelligence. Originally, theories in this area often explicitly or implicitly treated particular abilities as analogous to creativity but it is becoming increasingly apparent that the various abilities and cognitive styles which have been found to relate to creativity are components which may be functional at only some stages of the process and in varying degrees.¹

a) Associational abilities

The idea that creativity involves the ability to form numerous and unusual associations has led to considerable research. Mednick's Remote Associate Test and its

¹

see sections on Measurement of Creativity and Cognitive Style and Creativity.

underlying assumptions (Mednick & Mednick, 1967) has been at the hub of this work. Although the validation evidence concerning this test, especially construct validity, is not extensive and contradictory results have been obtained, remote associative ability does seem to relate to some external criteria of creativity (Mendelsohn, 1976). The associationist tradition has been revitalized recently in the theoretical and empirical work of Rothenberg (1973a,b, 1976, 1978). The capacity to conceive one or more opposite concepts simultaneously, for which he has coined the term "Janusian thinking", has been operationalized as "rapid opposite responding" on a word association test. Some support for the contribution of this ability to at least some forms of creativity, has been demonstrated (Rothenberg, 1979). Although Rothenberg found that rapid opposite responding had better discriminative validity than originality of verbal associations (Rothenberg, 1973b), moderately unusual associations were found to relate to rated creativity in Gough's (1976) samples of architects, research scientists and engineering students.

b) Divergent thinking

Divergent thinking ability, extricated from early models of intelligence (e.g. Guilford's Structure of Intellect, Guilford, 1959), stood alone for many years as being the source of imaginative and creative processes. The proliferation of divergent thinking tests is unparalleled in the history of creativity measurement. Research with adults has tended to be dominated by the Torrance Tests of Creative Thinking which is a battery of subtests, in both figural and verbal forms, measuring a range of "subabilities" considered to define divergent thinking e.g. fluency, flexibility,

originality. A clear definition of the concept is difficult to find apart from the necessary criteria of ideational fluency and remoteness. It is interesting to note that Torrance himself is moving away from the original focus on divergent abilities in his recent revision of the test battery (Torrance & Ball, 1980) and giving equal weight to a number of additional and diverse subabilities as contributors to creative problem-solving. In fact he emphasizes the importance of synthesis and integration of cognitive processes in creativity (Torrance, 1979a) which departs considerably from the divergent thinking tradition.

c) Additional areas of investigation of cognitive processes

Dillon (1982) provides a comprehensive review of the literature which falls under the rubric of "problem-finding". Although this behavior is often considered essential to creative thinking and has been noted in many writings in this area, the only theoretical and experimental work which deals with it explicitly has been by Getzels & Csikszentmihalyi (e.g. 1975). A study by Kasperson (1978) concerned with the relationships between creativity, question asking and information-seeking behaviour, represents a further extension of this crucial new interest area. In a sample of scientists classified in terms of creativity and productivity, significant differences in information-seeking behaviour were found for:

- 1) exposure to people outside their own area of expertise i.e. creative scientists scored higher on this variable than productive scientists who scored higher than noncreative/nonproductive scientists.
- 2) frequency of access to published accounts of original

research (similar patterns of results to above).

A discriminative function correctly classified 54% of the subjects using five variables of information seeking behaviour, with greater accuracy obtained in identifying creative scientists than for productive.

Another area of cognition which has attracted increasing attention in the literature on creativity is analogical and metaphorical abilities. The interested reader is referred to Arieti (1976), Khatena (1975), Stein (1978) and Harrington (1980) for a sampling.

d) Imagery and Creativity

The role of imagery in the creative process has received recognition by a number of investigators working in the area of mental imagery (Sheehan, 1972; Richardson, 1969; Paivio, 1971) but only cursory mention in much of the literature on creativity. Recently, several advocates have conducted more specific investigation of the interrelationship of imagery and creativity (Forisha, 1978, 1981; Rhodes, 1981; Khatena, 1975; Kaufmann, 1981). Forisha (1978) reviewed the limited work in this area and concluded that the contradictory and inconclusive results arise from an oversimplistic perspective, a lack of consideration of the variability and complexity of both mental imagery and the creative process.

The research which has focused on this area, has been limited to measurement of vividness and control dimensions of imagery, usually visual imagery alone. This has occurred in spite of some evidence that imagery modes other than visual are involved in at least some forms of creative thought (Khatena, 1975) and recognition of imagery

dimensions additional to vividness and control (Paivio, 1971; Richardson, 1969). However, the development and validation of measuring instruments has been slow and this has influenced the direction of empirical investigation. Some of the issues in measurement of visual imagery which are relevant to the present study will be reviewed briefly. For a more thorough discussion of imagery assessment see White, Sheehan & Ashton (1977) and Richardson (1977a).

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a. Vividness of Imagery

The controversy over the validity of vividness scales has centred around the inference of actual cognitive processes from self-report. The nature of what self-rating vividness scales are measuring is still open to question (White et al, 1977). However, there is evidence to support their predictive utility. Much of this work has been in the area of memory. Studies which have measured stimulus imageability, for example, have found subjects' self-ratings or introspective reports on vividness of imagery demonstrate predictive utility for memory performance within subjects and between stimulus items but not between subjects and within stimulus items (Richardson, 1980). The Vividness of Visual Imagery Questionnaire (VVIQ) developed by Marks (1973), has been found to predict accuracy of recognition and recall of pictures and concrete words. However, in one study (Marks, 1972) which examined recall improvement using a mnemonic device, imagery vividness rated prior to the task did not predict performance but vividness of imagery during

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The term imagery refers to visual imagery throughout the literature review unless otherwise stated.

the task was significantly related. Richardson (1980) found significant correlations with dream recall frequency and VVIQ Eyes Open Scores (females only) and Eyes Open and Closed for males. A small study reported by Richardson (1980) found subjects who experienced hypnagogic and hypnapompic imagery rated themselves higher on VVIQ. Significant but moderate correlations have been found between vividness (VVIQ) and hypnotic susceptibility (Richardson, 1980).

One of the difficulties inherent in a self-rating scale of imagery vividness is the requirement that the subject make an absolute rating. Richardson (1980) explains that a person can only experience his own mental imagery and since it is a qualitatively different experience from others, there is no absolute criterion for rating the vividness. The predictive validity then is questioned by Richardson. Evidence reported by Marks (in press) offers some justification for intersubject comparison on the basis of vividness self-ratings. He found that imagery reports can themselves be predicted by the more objective perceptual measures of eye fixation rate, saccadic distance and scanpath consistency.

Biases in vividness ratings have been indicated in previous research, particularly a social desirability response bias, as measured by Crowne & Marlowe's (1964) Social Desirability Scale. Ernest (1977) reviewed the available evidence and concluded that the Betts QMI Vividness of Imagery Scale seems prone to such influences, particularly in males. Di Vesta, Ingersoll & Sunshine

(1971) factor analysed performance scores on a large number of ability tests and found that introspective questionnaires on mental imagery contributed only to a factor defined by the Social Desirability Scale. However, Marks (in press) comments that although vividness ratings may be subject to demand characteristics "comparisons between subjects who characteristically report radically different imagery when tested under identical conditions would not be confounded by different demand characteristics." This point must be borne in mind when evaluating the literature which has demonstrated predictive utility of imagery vividness measures.

White et al (1977), reviewing test-retest reliabilities for vividness scales, found reliability correlations tend to drop in magnitude as the interval lengthens. They comment that subjects are apparently not responding only to the image vividness in their ratings. Generally the reliabilities of these measures are quite high though, ranging from .62 to .92 for Marks' VVIQ (White et al 1977).

b. Control of Imagery

Visual imagery is considered by some psychologists to vary on a number of dimensions as well as strength or vividness, such as passivity/activity, anticipatory/reproductive, flexible/rigid and controlled/autonomous (Forisha, 1978). The latter, defined as the ease with which an image can be altered or replaced by another (Richardson, 1977a) has been the only one subjected to any degree of empirical investigation using Gordon's Control of Imagery

Questionnaire (GCIQ) (Gordon, 1949) or later modifications (Richardson, 1969). As with imagery vividness measures the test-retest reliability of this measure tends to decrease over time, e.g. $r = .84$ at 3 weeks interval and $.60$ at one year in one study (White et al, 1977).

The implication that low control means autonomous images are experienced has not been clearly established but is generally accepted in theory, as is a degree of independence between vividness of imagery and control. The latter belief has received some support in the literature. Relationships found between these two dimensions include both statistically significant and nonsignificant results (White et al, 1977). Factor analytic evidence generally loads both on the same factor (Di Vesta, et al, 1971; Forisha, 1978) which seems to be independent of other cognitive and temperament variables (Richardson, 1977a). Ernest (1977) suggests that correlations between VVIQ and control measures may be due to the former requiring some manipulation of memory images. One would also expect a degree of association amongst low scorers on vividness, for whom lack of control would result from the vagueness or nonexistence of the image to be controlled (Richardson, 1972). Starker (1974) found an unexpected relationship between GCIQ and the Visual Imagery in Daydreams scale, presumably a measure of a passive, spontaneous mode of mental imagery, which was stronger than the correlation between the GCIQ and Bett's QMI, which requires active, volitional visual imaging. This finding complicates still further the unanswered question of what the GCIQ is actually measuring. It seems to share some variance with self-ratings of vividness, spontaneous passive

imagery and with some forms of spatial ability (Ernest, 1977). Richardson (1977a) found a significant correlation between the GCIQ and "Cutting a Cube", a spatial manipulation task, but not with Necker Cube Fluctuations, a measure of perceptual control. However previous research reviewed by Richardson indicated that the latter was clearly associated with imagery control and he advocates it's use as an objective measure of this dimension of imagery. A study by Downey, cited in Richardson (1972) found scores on vividness and controllability of imagery did not load on any factors defined by a selection of spatial visualization tasks.

Horowitz (1972) differentiates low control scores into two types of imagery experienced, a) very intense images which cannot be dispelled, b) inability to form images, but with the qualification that both types may occur in the same person. This distinction becomes important when interpreting the functional significance of a low score on the GCIQ. Paivio (1971) discusses the possible interference of uncontrolled visual imagery in tasks where the output is visual in the context of a channel capacity model. From this perspective one could hypothesize that a situation which increases awareness of imagery could influence behavior in two ways; if imagery is congruent with the task demand it would enhance performance and if incongruent, would interfere. Gordon (1972) suggests that the vividness of the imagery experienced would influence the interference effect. The predictive validity of the GCIQ in memory performance has received little attention and the existing empirical results are equivocal (Richardson, 1980).

An additional area of complexity in interpretation of the control dimension follows the results of White & Ashton's (1977) study on the internal consistency of the GCIQ. They found 4 factors involved in the total score, which they labelled Movement, Misfortune, Color and Stationary, according to explicit item content. No theoretical explanation for the difference between these factors exists as yet but White & Ashton's (1977) work indicates a functional discrimination. A significant correlation between control of imagery and recall of concrete pairs occurred only with the Movement factor.

Control of imagery has been associated with rigidity and stereotypy of imagery i.e. adaptability to ongoing experiences (Sheehan, 1972; Richardson, 1972) and also to personality and cognitive styles (Forisha, 1978). Richardson (1977a) suggests, on the basis of his results and other research, that imagery control may be a manifestation of the broader cognitive ability, adaptive flexibility. The importance of personality orientation, both in utilization of imagery in performance and interference effects, is stressed by Forisha (1978). Empirical evidence that bears on this issue is sparse at present. There are many similarities in personality correlates which have been found for high imagery types and those which have been cited in the literature on creative persons. An early study by Dunn (Sheehan, 1972) looked at the performance of extraceptive and intraceptive personality types on a word association task. The latter reported more complex mediating processes, especially visual imagery. Khatena (1975) found a significant relationship between vividness of visual imagery

and creative self perceptions. This relationship may reflect an awareness of inner processes, both visual imagery and creative thinking styles, or result from similar developmental experiences leading to both (Forisha, 1981). Alternatively, vivid imagery experiences may lead to a creative self concept in a more causal relationship.

c. Verbalizer - Visualizer Cognitive Style

Richardson (1977b) developed the Verbalizer-Visualizer Questionnaire (VVQ) to measure individual differences on a verbal-visual dimension of cognitive style. Items were empirically selected from Paivio's (1971) Ways of Thinking questionnaire on the basis of discriminating power between habitual left- and right-movers (conjugate lateral eye movements). The theoretical and empirical literature on conjugate lateral eye movements as a marker for hemispheric laterality is reviewed in Chapter IV. The VVQ was found to have acceptable test-retest reliability and internal consistency, although the latter was less so with male subjects. Social desirability did not appear to influence responses on the scale (Richardson, 1977b). Validation studies indicated relevant prediction of visual imagery vividness, vocabulary scores (Mill Hill) and physiological events i.e. irregular breathing, which previous research has linked to verbalizing tendencies (Richardson, 1977b). However, the association between cognitive style on the VVQ and eye movement categories was reversed in direction and statistically significant, in one replication study by Richardson.

Edwards and Wilkins (1981) examined the construct

validity of the VVQ. In a multiple regression analysis only 9% of the variation in scores was accounted for by visual imagery measures (GCIQ, QMI, 2 spatial abilities tests), and this was mainly by the subjective imagery scales. In a second study they categorized each subject as verbalizer, a visualizer or mixed. There were no main effects or interactions for the factors of cognitive style and sex of subject, on the imagery scales. These results cast some doubt on the assumptions underlying the structure of the VVQ that verbalizing and visualizing cognitive styles are negatively related i.e. at opposite ends of the continuum. An alternative hypothesis which has been proposed (Paivio, 1971) is that these cognitive processes are functionally parallel and independent but usually both operate in unison. A study of professional problem-solvers, by Maivardi (cited in Richardson, 1969) found that the thinking processes of these subjects showed constant alternation between abstract/verbal modes and concrete/imaginal modes. A continuum model of cognitive style would be inadequate and inaccurate for both the above perspectives of cognitive functioning. In examining the validity of the VVQ it is also necessary to consider the evidence supporting the assumption of hemispheric lateralization of visual imagery processes inferred from lateral eyemovement biases. Bakan (1969) found that left movers reported more vivid visual imagery but the difference was not significant (.10 level). The same author (Bakan, 1980) found right movers performed better on spatial-visualization tests and that vividness of visual imagery (QMI) was positively but nonsignificantly related to right eye movements. The GCIQ was not related to eye movement categorization and was also negatively related

to most of the spatial-visualization tests. To account for these contradictory results, Bakan proposed a model describing "raw" and "cooked" imagery - utilization of imagery in some form of problem-solving may involve the left hemisphere whereas "raw" imagery may be right lateralized. He cites as support two independent studies among mathematicians which found left movers reported more frequent use of visual imagery in their work.

Some objective evidence supporting Bakan's proposition is offered by Gur & Reivich's (1980) study. They recorded hemispheric blood flow during cognitive tasks and found a significant increase to the left hemisphere relative to the right during a verbal task. Although there was no relative increase to the right hemisphere during a spatial task, the degree of increase in blood flow was related to level of performance on the spatial tasks. The authors suggest that spatial problems appear to be solvable by either right or left hemisphere strategies although the results indicate that right hemisphere activation is associated with better performance. In support of lateral eye movement measurement as an index of hemispheric preference or bias, they found that left movers had significantly more flow to the right compared to the left hemisphere when recordings were averaged across all questions.

d. Visual Imagery and Creativity

Before proceeding to the functional significance of imagery in creativity, an issue relevant to the predictive utility of imagery measures requires comment. As previously

mentioned the high test-retest reliabilities for imagery scales indicate fairly enduring characteristics. However, the use of imagery as a mediator in performance is not necessarily consistent for an individual. Lindauer's (1977) aesthetic individuals differed from non-aesthetics in their ability and/or preference to call upon their imagery but not on the magnitude of vividness ratings. Paivio (1971) outlines several conditions which determine choice of mediation mode. These are a) stimulus characteristics, including interest, affect, meaning and overall level of arousal evoked by the stimulus; b) situational characteristics such as experimental instructions and task demands; c) individual differences in imaginal and verbal associative abilities. One source of support that Paivio suggests for the first condition are findings that have been consistent with the view that nonverbal imagery is functional with concrete tasks e.g. experimental physics, whereas verbal thinking is demanded by more abstract tasks e.g. theoretical physics. Relevant to the second condition, Kaufmann (1981) offers some interesting evidence on the use of visual imagery as a mediator in problem situations which demand novelty. In ideational fluency tasks ideas which are given initially tend to be conventional and stereotyped while more original ideas occur later (Parnes, 1961). Kaufman found the prediction efficiency of a measure of imagery ability for performance on the Unusual Uses test, systematically increased with time spent on the task. The form of stimulus (verbal or pictorial) had no influence on imagery utilization. A spatial manipulation test was used as a measure of imagery ability. However, there does not seem to be a strong relationship between spatial ability and

vividness or control of imagery (Richardson, 1977a) which does limit generalization from Kaufmann's results. Paivio (1971) suggests that the strong motor component in visual imagery contributes to its usefulness in symbolic transformational thought, and in integrating units of information into meaningful relationships. Imagery may contribute flexibility and speed to transformations involved in mediated learning.

The research which has focused specifically on the role of visual imagery in the creative process has generally used associational fluency tasks with the implicit view that creativity is analogous to divergent thinking. This viewpoint is oversimplistic (Belcher & Rubovits, 1977; Heccevar, 1981). However, experimental work using other criteria is sparse. Two studies using problem-solving situations other than divergent thinking will be mentioned before reviewing the main focus of the literature.

Durndell & Wetherick (1976) found that imagery vividness and control were unrelated to the time taken to solve a problem which required the breaking of a mental set. Additionally, they administered a completely visual concept task and a completely verbal concept task to examine facilitative or hindrance effects of visual imagery ability. Again, no relationship was obtained. Uncontrolled vivid imagery was not found to be a hindrance in problem-solving nor was controlled vivid imagery helpful, as Richardson (1969) predicted. In an unpublished study by Forisha & Nagy (Ernest, 1977) a significant correlation was found between the visual scale of Bett's QMI, and the Remote Associates

Test.

Interpretation of the range of results from studies using divergent thinking tasks, requires discriminating the studies in terms of the output mode of tasks used, total scores or breakdown of processes involved in performance (e.g. Fluency, Flexibility, Originality) and statistical analyses used including sex differences.

e. Verbal Tasks

Using verbal tests, such as Unusual Uses or Alternate Uses, significant correlations with vividness of imagery have been obtained by Forisha & Nagy (unpublished), females only, Forisha (1978) males only and in another study by the same author negative correlations occurred. Ernest (1977) obtained a positive relationship with no sex breakdown.

Relationships between control of imagery and verbal tasks have generally been stronger and more consistent. Ernest (1977) and Forisha (1975 unpublished) obtained positive correlations but in a more recent study Forisha (1978) found no significant correlations for males. Summing control and vividness scores into a total imagery score, Forisha (1981) found that correlations were more consistent and stronger in some academic disciplines than others, using a student sample.

In a factor analytic study, Paivio's (1971) results loaded vividness on a different factor than verbal associational ability (Alternate Uses test). However, Forisha (1981) found verbal scores on Torrance's Unusual Uses test loaded together with vividness and control on one

factor and in the opposite direction on a second factor, suggesting an interference effect in some cases.

f. Figural Tasks

Figural forms of divergent thinking tasks have been used less often than verbal although the results indicate the role of imagery may differ between the two modes. Rhodes' (1981) investigation with 6th grade students, found vividness correlated significantly only with Elaboration on the Figural form of Torrance's Tests of Creative Thinking (TTCT). Durndell & Wetherick (1976) and Forisha (1978) compared high and low scoring groups on imagery measures of control and vividness. The former study resulted in a significantly better performance by high controllers on 2 figural tasks but there was no difference with the vividness groups. In the latter study Forisha obtained a similar pattern of correlational results as with the verbal tests i.e. a negative relationship for males. However, when divided into high and low scorers there was an interaction effect only with the figural form. High scores on both imagery dimensions performed best but those who were low on the two dimensions also performed better than subjects high on one and low on the other.

Summarizing these results, vividness of imagery is related to verbal divergent thinking, more consistently for females, and usually the relationship is moderate. When there has been a breakdown of subscores on the tests, this relationship appears more often with fluency than originality. Control of imagery is more strongly correlated than vividness and again occurs most consistently with

females. In some cases, however, imagery seems to hinder verbal performance. Vivid imagery alone does not appear to enhance performance on figural tasks except in elaboration, but does interact with controlled imagery to produce superior associational fluency. Inconsistencies which occur in the literature point to a modifying effect on sex differences and possible personality and cognitive variables which affect awareness of and utilization of imagery.

It is evident, from reviewing the literature, that Forisha's (1978) comments concerning the contradictory and inconclusive results are well justified. Ainsworth-Land (1982) concurs with the view that this state of affairs arises from lack of consideration of the variability and complexity of both mental imagery and the creative process. He virtually stands alone in attempting to integrate these two areas in a theoretical model. The model is developmental, outlining progressive stages of creativity and accompanying imagery processes (Table 1). Rather than movement along a continuum of imagery dimensions e.g. vividness and control, higher levels involve a combination of imagery processes. For example, at the second highest level "one must be able to create a mood of receptive spontaneity, to be open and have access to more unconscious material, yet to direct and manipulate imaging to fit with a purpose or goal" (p.15). Predictive utility of existing imagery ability measures for creativity would be minimal within this framework.

TABLE 1
DEVELOPMENTAL INTEGRATION OF CREATIVITY AND IMAGING
(Ainsworth-Land, 1982)

Imaging	Creativity		
Orders	Self-Involvement	Product	Processes
1st order ---> spontaneous, sense- based, concrete direct representation, realistic	non-awareness of "self", creating out of need, survival motivation, "self-creating"	realistic, concrete representation, discovery learning, memory building, invention	perceiving, exploring, spontaneous acting
2nd order ---> comfortable, predictable, awareness of ability to manipulate and control, analogical, comparative	belonging, self-extension, goal directing, ego building and verifying, self consciousness	improvements and modifications, impressions, strengthening and enhancing, analogical	catagorizing, comparing, analyzing, evaluating
3rd order ---> abstract, symbolic, superimposing, metaphorical, controlled and spontaneous	sharing differences, "selves" realization and reintegration, giving up rigid control, opening to "flow"	innovation, integrated synthesis of old and new abstractions, symbols	abstracting, synthesizing, combining, metaphorical thinking, intuiting
4th order ---> renunciation of control, chaotic, psychodelic, illuminating, receptivity to unconscious material	self as part of larger reality, "meta-consciousness", disintegration of barriers: conscious-unconscious	invention of new order, new paradigm, philosophical shifts, new pattern formation, "inspired" creations	disintegrating, surrendering, accepting, opening, building new perceptual order

g. Imagery Training

The implication from the literature is that visual imaging ability is a fairly enduring characteristic and that utilization of imagery as a cognitive style also shows some intra-subject consistency although conditions such as task demands may influence situational variation. If imagery processes do enhance creative performance the impelling question arises of the benefit of imagery training. Marks (in press) suggests that awareness of imagery and purposeful utilization is learnable with appropriate experience and training. He cites, as support, a study by McKellar, Marks & Barron, in which both good and poor visualizers were able to make significant improvement in recall by learning an imagery strategy. Mere instructions to use imagery appear insufficient in altering performance (Durndell & Wetherick, 1976) even where imagery is strongly associated with performance level.

Training techniques for enhancement of creativity (e.g. Parnes, 1967; Torrance & Hall, 1980) generally do not focus specifically on imaging processes although there is often an indirect focus such as increasing receptivity to sensory experiences. Ainsworth-Land (1982) describes a need to set aside judgements for enhancing awareness of imaging and touts the benefits of perceptual awareness training. His theoretical model implies that training techniques focusing on creative thinking, such as ideational fluency, and generating facilitative attitudes and emotional involvement, will lead to accompanying development in imagery utilization.

3. ENVIRONMENT

Experimental research on environments facilitating creativity is comparatively lacking. Although environmental influences, whether facilitative or inhibitive, are occasionally mentioned in discussions of creativity, the characteristics described tend to be extrapolations from personality features rather than empirically determined. For example, Douglas (1977) summarizes the work by Barron on creative personalities, then states "It follows that the creative environment is one that encourages this through...", resulting in a specious argument.

On the other hand, some writers dismiss the study of environmental influences by promulgating the variability between individuals. This tack becomes particularly convincing when one reads biographical accounts of the facilitative conditions for eminent people such as Schiller who preferred having the smell of rotten apples emanating from the desk drawer, when he wrote poetry (Spender, 1946).

MacKinnon (1978) comments that "to speak of a creative situation is to imply that creativity is not a fixed trait of personality but something that changes over time, waxing and waning, being facilitated by some conditions and situations, and inhibited by others" (p. 52). Although this assertion would be superficially accepted by most, in fact the assumptions underlying most of the experimental work, particularly test development, are directly contrary.

The two areas which have received some empirical

attention are peripheral to the main focus of this thesis, consequently they will only be mentioned briefly. A psycho-historical study of cultural and societal characteristics which produce clustering or "golden ages" of creative accomplishment has been taken up by a number of individuals (e.g. Arieti, 1976; Gowan & Olson, 1979). Arieti proposed a model of the "creativogenic society" which included nine necessary conditions but the sufficient condition was the creative person himself. The only substantive empirical enquiry into creative climates has been in the field of industrial psychology. James & Jones (1974) and Kilmann, Pondy & Slevin (1976) provide useful overviews of the work in this area, covering topics such as organizational structure, attitude and expectations.

4. PRODUCT

Focus on the creative product has tended to be either as the source for deducing the stages or processes involved in creation, or as providing objective criteria against which creativity measures or individual differences are validated. An impressive example of the former is Gruber's (1974) book "Darwin on Man", an in-depth study of Darwin's development of evolutionary theory. Perkins (1981) criticizes this method of investigation, asserting that after-the-fact accounts have questionable validity; even good physical traces such as notebooks, sketches, disclose little about judgements, aims and process.

The use of the creative product appeals to some researchers as an objective criterion of creativity. Often

this leads to the study of socially defined "creative fields" such as the arts, and the labelling of individuals in these fields as producing creative products even though there is a vast variation in quality. In fact, product rating is far from an objective measure. The dimensions which are used for rating, the frames of reference and the subjectivity of rater judgements, particularly on some of the more nebulous dimensions such as elegance or impact, vary from study to study. MacKinnon (1978) separates crucial criteria, such as novelty and adaptiveness from optional criteria which are seldom met e.g. transcendence, transformation, social impact. However, until there is a consensus about what criteria determine the creative product, all research using this approach in experimental design will leave something to be desired.

5. MEASUREMENT OF CREATIVITY

A considerable number of measurement instruments have been developed over the last quarter century in an attempt to identify creativity. The multifarious tests can be categorized broadly as focusing on the person i.e. cognitive process variables such as divergent thinking/remote associative ability, or personality, attitudes, motivation, interest, biographical information (singly or combined). The diversity in instruments is indicative of both the complexity of creativity as well as different goals, research designs, subjects and settings (Hocevar, 1981). Although the perspectives are diverse, the underlying assumption with the majority of tests developed, has been that creativity is a unitary, normally distributed trait,

(e.g. Richards, 1976; Hocevar, 1976). As the evidence is reviewed on the reliability and validity of some of the most commonly used tests, it will become evident that this assumption is not supported, as is suggested by Nicholls (1972).

a) Cognitive processes

Divergent thinking has frequently been considered analogous to creative thinking and has been prevalent in attempts to identify creative potential. Divergent thinking tests have an 80 year history beginning with Binet (Binet & Henri, 1896). Other influential works in this area have been produced by Guilford (1959, 1967, 1976), Wallach & Kogan (1965) and Torrance (1974). The Torrance Tests of Creative Thinking is the most extensive battery, with alternate forms in both verbal and figural modes, and has received considerable theoretical and empirical attention. Although the test author describes the battery as measuring a constellation of generalized mental abilities that are commonly presumed to be brought into play in creative achievement (Torrance & Ball, 1980) and the most recent revision includes a number of new criterion variables which attempt to "capture the essence of those kinds of creativity that fall outside the realm of pure reason" (p. 84, Torrance & Ball, 1980), in fact the normed measures refer to the standard dimensions of divergent thinking i.e. fluency, flexibility and originality. Holland (1968) reviewed the evidence on the Torrance Tests available at that time and concluded that satisfactory test-retest reliability and equivalent forms reliability was demonstrated. The validity evidence, concerned mainly with construct and concurrent validation, was not as conclusive although internal

consistency and consistency with the literature on creative behaviour was indicated. Holland suggested that explicit evidence was needed about the tests' ability to predict socially relevant creative behaviour.

Since Holland's review construct validity remains under fire from some directions (Plass, 1974; Hocevar, 1979a,b). However, criticism of divergent thinking tests has predominantly been directed at their reliability and validity from two main directions a) the moderating effect of testing conditions and instructions b) the predictive validity for creative achievement. The various studies on testing conditions generally support an enhancement of ideational fluency with game-like conditions, particularly in the figural mode (e.g. Hattie, 1977) although there is some evidence that a formal, test-like condition is optimal for verbal performance (Hattie, 1977; Torrance & Ball, 1980).

The empirical findings on the influence of instructions are equivocal. Instructions to "be original" have been found to increase originality but applying further constraints such as "be original and practical" produced little effect (Manske & Davis, 1968). Harrington's (1975) findings contraindicated this distinction. He instructed subjects to "be creative", defining this as having both novel and worthwhile ideas. This resulted in an increase in creative responses as well as stronger relationships between divergent task scores and creative personality scales, e.g. the Creative Person Scale (Gough, 1979), thus improving construct validity. However, improvement in performance

only occurred with high scorers on the Creative Person Scale; low scorers showed a decline in performance when instructed to be creative. Harrington interpreted these results as a motivational effect, the low scorers being threatened by the task demand created by the instructions and the highly creative subjects, as identified by the Creative Person Scale, rising to the occasion, so to speak. A more recent report by Katz & Poag (1979) replicated some aspects of these studies for males but not for females. They suggest that the facilitative effect of instructions is not due to heightened motivation but to disambiguation of situational demands.

Crockenberg (1972) questions the external validity of divergent thinking tests as they lack qualitative standards e.g. the worth, value and adaptiveness of ideas. The conclusion reached in the majority of reviews on the subject is that divergent thinking tests may, under some conditions, measure abilities which are related to creative achievement and behaviour but the particular relationships may be field specific (Barron & Harrington, 1981), as well as vary between individuals as a result of other cognitive or personality factors. This would explain the inconsistent and sometimes contradictory evidence on concurrent validation (e.g. Goolsby, 1975; Davis & Belcher, 1971; Nicholls, 1972).

In spite of the insubstantive support from correlational studies, a longitudinal experiment by Torrance (1969, 1977) provides some external validation. Sixty-nine high school students, tested with the original version of

the Torrance Tests in 1959 were followed up 7 and 12 years later and assessed for their creative achievements in educational and employment settings. Gross trends reported by Torrance (1977) indicated that creative achievements in writing were more easily predicted than any other field, followed by achievement in science, medicine and in leadership. Only figural divergent performance yielded significant positive relationships in the visual arts. For achievement in business and industry, significant relationships occurred only for verbal divergent performance. For creative writing, especially high correlations occurred with verbal flexibility and originality in the "causes" and "consequences" tasks. At the 12 year followup a far greater percentage of high creatives than low (as assessed in school testing) were still searching for new goals and perceived themselves in the process of being creative personally and in their careers.

In addition, there is some evidence that within divergent tasks there are dissimilarities, in correlations of submeasures to creativity compared to total task performance. Apart from evidence of this offered in factor analytic studies (Belcher & Rubovits, 1977) the independence of cognitive processes involved in divergent thinking and in correlates of these is indicated by Bachtold's (1982) study. He related temperament characteristics to the scores on the normed measures of the Torrance Tests. No difference in temperament were found between high and low scorers on figural fluency and originality but there were differences relating to ability in verbal elaboration, figural

elaboration, verbal flexibility and originality. From their results the authors proposed that individuals who use verbal complexity in divergent processes tend to be constitutionally very emotional, whereas those who use figural complexity have high activity levels and are quick to respond to stimuli. Persons who are verbally imaginative and diverse in their ideation tend to be by nature more solitary.

Regardless of the veracity of Bachtold's propositions, his results together with factor analytic evidence suggest the importance of considering divergent thinking tests as measuring a complex behaviour rather than a unitary cognitive ability described in a total performance score.

b) Personality and attitudes

Personality inventories characterize creativity as a set of personality factors rather than cognitive traits. The Adjective Checklist has been the source of several empirically derived creative personality scales (e.g. Domino, 1970), the most recent revision by Gough (1979) consisting of 30 items and demonstrating improved discriminative power. The creative personality scales from the Adjective Checklist are the most widely used and well-validated inventories of this type. The extensive empirical validation of the most recent scale, the Creative Person Scale, is based on a diverse range of subject samples and creativity criteria (Gough, 1979; Albaum & Baker, 1977). However, correlations seldom exceed a moderate strength of .3, which is similar in magnitude to the predictive strength

of divergent thinking tasks (Hocevar, 1981). The Creative Person Scale (CPS) is an indirect self-concept measure, consonant with the prevailing attitude in psychological measurement that individuals are inaccurate in assessing their own abilities. Both Hocevar (1981) and Davis (1975) assert that creative subjects are fully aware of their own creative abilities and a direct evaluative approach would be useful though it has been rarely used. As indirect self-concept measures like the CPS can be faked to some degree (Ironson & Davis, 1979) the control on response bias gained with an indirect method may lower predictive validity due to insufficient information. A recent creative personality questionnaire, developed by Holmes (1976), incorporates many of the personality, attitudinal and cognitive style correlates of creativity which have been identified in previous investigations. This scale is one of the few reasonably comprehensive direct measures to have been developed. Unfortunately there is no validity evidence cited by its author and the test is not conspicuous in the recent literature on creativity measurement.

Attitude inventories are based on the assumption that a creative person will express attitudes and interests favouring creative activities. One of the original instruments in this area was the Barron-Welsh Art Scale in which the preference for relatively complex, asymmetrical drawings has been found to relate to other relevant variables of creativity. However recent evidence has indicated little predictive utility and questionable construct validity for the study of creativity (Ridley, 1977). A more recent attitudes/interests scale which

attempts to improve validity by taking a multidimensional perspective is Taylor's Creative Behaviour Disposition Scale (Taylor, 1976). As with the Holmes scale, this instrument is a direct evaluative measure and possesses face validity to the extent that it recognizes complexity in creative behaviour. Taylor (1976, Taylor & Fish, 1979; Taylor, Sutton & Haworth, 1974) reports a high degree of internal consistency and significant correlations between some of the subscales, particularly the "disposition" subscales compared to the "area" subscales, and divergent task measures. However relationships varied considerably in their magnitude and significance level as well as variables involved, across two samples cited by Taylor (1974, 1976). As this measure has not been used in other published studies, support for its utility remains unsubstantiated.

Biographical inventories have been considered by some to be the best measure of creativity (Hocevar, 1981; MacKinnon, 1978) and certainly a prevailing opinion in psychology is that future behaviour is most successfully predicted by past behaviour. Studies with eminent subjects have generally supported this contention (e.g. MacKinnon, 1978) however the purpose of creativity measurement is usually to identify potential rather than confirm socially recognised achievement. This difficulty applies to all extant tests of creativity: cognitive processes, interests, personality and past experiences. At present the evidence can only be considered to support their use when the goal is explanatory rather than selective. The concept of creativity as a normally distributed trait is not supported by the available evidence (Nicholls, 1972) and the use of a

single test as a measure of creativity is not warranted.

No single test is sufficient to measure creativity, nor apparently is the conglomerate. Generally, factor analytic studies have found process/cognitive variables to be independent of personality/attitudinal/motivational variables as measured by creativity tests (Belcher & Rubovits, 1977; Belcher, Rubovits & DiMeo, 1981; Arbet, 1977; Hocevar, 1981). Belcher et al. (1981) examined the interrelationships among 10 representative tests of creativity, including personality, attitude, motivation and cognitive process tests. The five factors generated accounted for only 56% of the variance. They recommend a shift in perspective in creativity measurement; rather than attempting to develop a single test of creativity, what should be assessed are identifiable and manipulable factors that lead to increased creativity.

CHAPTER III

EXPERIMENT 1: A FRESH LOOK AT THE INTERRELATIONSHIP OF
PERSON AND PROCESS VARIABLES ASSOCIATED WITH CREATIVITY

RATIONALE

The purpose of the initial study was to examine the interrelationship of selected person and process variables and environmental influences on these, in a sample of individuals which included a range of creative abilities as well as creative achievement. The goals were two-fold;

(1) verification of empirical results and theoretical formulations from previous literature in a sample of individuals who were not pre-selected for demonstrated creative achievement.

(2) an exploratory investigation using a multivariate design in order to raise new or alternative questions to those which have been previously addressed. These have usually arisen from a traditional psychological orientation and typically have used a bivariate experimental design which does not recognize the complexity of creative behaviour. These constraints may limit generalizations from the literature on creativity.

Relevant to the first goal, measures of personality and cognitive process which have received the strongest validation evidence were selected e.g. Creative Person Scale, Torrance Tests of Creative Thinking. In addition, a number of assessment instruments were included which have indicated potential utility in this area but have received

little empirical attention e.g. Holmes' Questionnaire, Taylor's Creative Behaviour Disposition Scale, visual imagery, information access behaviour and environmental perception.

METHOD

Subjects

A sample of 70 subjects was randomly selected from the academic, technical and secretarial staff of University of Canterbury, presumably representative of a range of creative ability and productivity. There were 56 males and 14 females in the sample; mean age was 39 with a range of 20 to 65 years.

Measures

Creativity scales - personality, attitudes, interests

1. Creative Person Scale (CPS) contains 30 adjectives from the Adjective Checklist (Gough, 1979), both indicative and contraindicative items. The scale was developed on the basis of item vs. criterion correlations across a range of subject samples, and has been validated against criteria of creativity such as ratings by expert judges, in the field of work, faculty members and life-history interviews.

2. Holmes Questionnaire (HQ) consists of 72 items which are rated by the subject on a 5 point scoring system from Strongly Disagree (1) to Strongly Agree (5). Developed by Holmes (1976) this is a direct creative self-concept questionnaire incorporating many of the personality, attitudinal and cognitive styles correlates of creativity

which have been identified in previous investigations. Respondents evaluate themselves in relation to "most people".

3. Taylor's Behaviour Disposition Scale (BDS).

Developed by Taylor (1976) this is a self-rating multidimensional measure of creative orientation based on the concept of "creative transactualization". The scale yields 10 subscores, 5 creative disposition scales: Expressive, Technical, Inventive, Innovative, Emergentive; and these are related to 5 areas of creativity scales: Person, Problems, Processes, Products and Climate.

4. Creative self-concept. A questionnaire developed by the experimenter to collect demographic and other subject data, included a question on self-concept in which subjects classified themselves in terms of creativity and productivity:

- (1) Creative/productive (2) Creative/unproductive
- (3) Uncreative/productive (4) Uncreative/unproductive.

Cognitive style variables

1. Marks (1973) Vividness of Visual Imagery Questionnaire (VVIQ). This scale is scored for Eyes Open, Eyes Closed and Total vividness. A higher score is associated with less vivid visual imagery. Consequently, correlation coefficients between highly vivid imagery and high scores on another variable result in a negative sign. To assist in comprehension of tabled results, correlations interpreted as a positive relationship with vividness are recorded with a positively signed coefficient.

2. Gordon's Control of Imagery Scale (GCIS).

Richardson's (1969) modified scoring system was used: Yes

(2); Unsure (1); No (0). The subfactors scores for Movement, Misfortune, Color and Stationary were also calculated (White & Ashton, 1977).

3. Janusian thinking. Rothenberg (1973 a,b) found that the capacity to conceive and utilize one or more contradictory or opposite concepts simultaneously (termed Janusian thinking) was associated with creativity. His operational definition of this capacity is rapid opposite responding. Measurement is based on common or opposite responding tendencies in a word association task and the latency interval in responding. The Kent-Rosanoff word list was used in this study, with Australian norms (Postman & Keppel, 1970). This was deemed most appropriate for a New Zealand sample. Stimulus words were presented singly on a computer terminal screen at regular intervals. Subjects were instructed to respond with the first word that occurred to them. Responses were scored for Commonality, Opposite Response Tendency and Rapid Opposite Responding which was based on Rothenberg's (1973) latency interval criteria. Response time was measured using a voice relay mechanism connected to the computer (see Appendix 1 for computer program). This task was administered following completion of all other measures.

4. Information access behaviour. Kasperson (1978) analysed the nature of information seeking behaviour which discriminated creative scientists. Based on his results, the following variables were elicited and scored from a questionnaire item asking subjects to list the main areas of interest in which they had fairly regular access to information and to indicate the source and frequency of access to the information.

Variables: Range of information sources

Frequency of access

Frequency of access to original research

Frequency of interpersonal sources of
information e.g. lecture,
conference, colleagues.

Creative performance

1. Torrance Tests of Creative Thinking (TTCT) Verbal and Figural Forms A & B. The modified scoring system for the figural forms was used (Torrance & Ball, 1980) which includes two additional normed subscores and a number of criterion measures of performance which are theoretically independent from ideational fluency and attempt to capture the essence of creativity elicited by the tasks. For example, figural tasks are scored for humor, expression of emotion, movement, unusual visual perspective, among other measures. Validation of these additional measures is extremely limited at present, apart from the author's study with high school students (Torrance & Ball, 1980). Appendix 2 gives brief descriptions of the measures.

Alternative forms of the tests were completed in two environments, Home and Work, with a minimum interval of two weeks. Time limits for the subtests were in accordance with the TTCT manuals (Torrance, 1974; Torrance & Ball, 1980) however strict adherence to the time limits is improbable as subjects completed the tests on their own. Hattie (1977) reviewed the literature on testing conditions with divergent thinking tasks and found little difference between timed and untimed administration.

Tests were scored independently by two trained research assistants. Adequate interrater reliability was obtained, ranging from .82 ($p = .000$) to .99 ($p = .000$).

2. Productivity. An objective measure of creative productivity, which did not rely on ratings by others, was established for the subgroup of academic staff. This was the total number of scientific or literary publications relating to their academic career published in the previous five year period.

3. Perception of environments. Environmental rating scales were designed to assess subject's perception of the work and home environments in which the TTCT tasks were completed. Questions were devised to measure the social climate dimensions which Moos (1974,1976) empirically identified as most influential in behaviour (see Appendices 3 & 4 for questionnaires). The dimensions assessed were:

Home - Cohesiveness, Expressiveness, Conflict, Independence, Achievement orientation, Intellectual-cultural orientation, Recreation, Moral-religious orientation, Organization, Control.

Work - Involvement, Peer cohesiveness, Staff support, Task orientation, Competitiveness, Pressure, Clarity, Control, Acceptance of innovation, Physical comfort.

Procedure

Personality style measures were completed by subjects individually prior to the TTCT tasks, apart from the BDS and Janusian thinking task which were administered following TTCT completion. The reasons for this were related to organizational problems rather than methodological intent. Consequently, self-ratings on the BDS may have been

influenced by the intervening tasks.

Subjects were randomly assigned to one of two instruction groups for TTCT tasks. The first group (Normal) received the standard instructions as outlined in Torrance's manuals (1974,1980). The second group (Be Creative) were instructed to "Be creative by thinking of as many solutions as possible which are unusual but also relevant." The order of TTCT forms (A & B) and environment for completion (Home & Work) was randomized across the sample.

The GCIQ was administered by a research assistant to allow sustained attention to the visual image being manipulated. This was in order to obtain an optimal assessment of imagery control. The VVIQ was completed twice with a 2 week interval. Only the total VVIQ score was used in analyses as there has been little evidence for differential predictiveness of Eyes Open and Eyes Closed scores (White et al., 1977). It was also considered that the total score would represent optimal vividness capacity.

A range of statistical analyses were conducted including bivariate and multivariate analyses. High and low scoring groups were calculated for GCIQ, VVIQ, BDS and CPS for analysis of variance. These groups were formed by dividing the distribution of scores at the sample means. Sex differences were not examined because of the low representation of females in the sample.

In order to avoid possible confusion, specific statistical techniques will be identified in the appropriate results section.

RESULTS AND DISCUSSION

1. DIFFERENCES BETWEEN ACADEMIC STAFF AND TECHNICAL/SECRETARIAL STAFF

University academic staff would be considered by many to represent a socially defined creative profession compared to technical/secretarial staff. The academic staff in this sample were identified as more creative by a range of personality, attitude and cognitive process variables. However there was considerable overlap in self-concept ratings in terms of creativity and productivity between the two groups. This suggests that with these particular employment roles, social evaluation has little influence on self-concept. The impact of role definition on creative self-concept may be modified in this sample by the overriding aura of an institution of "higher learning". The results also suggest that the more creative individuals were more accurate in their self-concept.

Analyses results are detailed in Appendix 6 as they were an interesting divergence but not integral to the general thrust of the investigation.

N.B. Raw data and SPSS data definition information for Experiment 1 contained in Appendix 10.

2. EFFECT OF ORDER OF ADMINISTRATION

Analysis of variance yielded a significant main effect for order, with three criterion measures of figural performance: Articulateness ($p = .05$), Unusual Visual

Perspective ($p = .006$) and Fantasy ($p = .04$). A significant interaction with environment occurred for both Verbal and Figural divergent thinking totals (Fluency, Flexibility, Originality) ($p = .000$). Higher scores were obtained on these measures if the first set of tests was completed in the work environment. The novelty of the initial administration of these tests appears to have enhanced qualitative aspects of figural performance. However environmental factors associated with the work environment, perhaps associations with goal-directed and time-limited activity, enhanced divergent thinking performance. These results indirectly support previous research which has found timed, test-like conditions to be optimal in divergent thinking tasks (Hattie, 1977). Familiarity and perhaps decreased enthusiasm in the second administration of the alternate form of TTCT tasks appears to have negated the influence of testing conditions.

3. VALIDITY OF SELF-CONCEPT CLASSIFICATION

1. Productivity

The objective measure of productivity was assessed for academic staff only. The differences between self-concept categories, in terms of publications, was nonsignificant (effects of order and instructions were adjusted for). Both categories of "productive" (Creative/productive, Uncreative/productive) tended to

1
no subjects classified themselves as uncreative/unproductive.

overestimate or overvalue their productivity as measured by this criterion i.e. the majority of subjects in these groups had fewer than the mean number of publications. The creative/unproductive group were highly accurate in their self-assessment, with 100% having fewer than the mean.

2. Creativity

Analyses of variance, adjusted for the effects of order and instructions, were performed on each TTCT submeasure, completed in both environments. There were no statistically significant differences between self-concept groups in TTCT performance. However some consistent patterns emerged and differences approached significance for a number of TTCT measures.

CREATIVE/UNPRODUCTIVE

This group obtained higher scores than the uncreative/productive group on almost all the TTCT measures in both environments. Their performance on figural measures, both divergent thinking and criterion, was superior to all self-concept groups and was most marked in the home environment. This is not surprising considering their non-involvement and negative perception of the work environment (see results for environmental ratings Table 2). The self-assessment as creative appears accurate for this group, in terms of creativity as measured by TTCT performance.

CREATIVE/PRODUCTIVE

These subjects obtained the highest scores of all groups on Verbal divergent thinking and Unusual Visual

TABLE 2
DIFFERENCES BETWEEN SELF-CATEGORIZATION GROUPS (CREATIVITY/PRODUCTIVITY)
ON ENVIRONMENTAL DESCRIPTIVE DIMENSIONS ¹

DIMENSIONS	ORDERING OF GROUPS ON DIMENSION			SIGNIFICANCE OF MEAN CONTRASTS
	HIGHEST		LOWEST	
H - INTELLECTUAL-CULTURAL ORIENTATION	CREATIVE/PRODUCTIVE (1)	CREATIVE/ UNPRODUCTIVE (2)	UNCREATIVE/PRODUCTIVE (3)	(1) + (3)*
H - INDEPENDENCE	"	"	"	(1) + (3)*
H - ORGANIZATION	"	"	"	NS
W - ACCEPTANCE OF INNOVATION	"	"	"	NS
W - PEER COHESION	"	"	"	NS
W - INVOLVEMENT	CREATIVE/PRODUCTIVE	UNCREATIVE/ PRODUCTIVE	CREATIVE/UNPRODUCTIVE	NS
W - PHYSICAL COMFORT	"	"	"	NS
W - CLARITY	"		(2) + (3)	NS
H - ACHIEVEMENT	"		"	NS
H - MORAL-RELIGIOUS ORIENTATION	CREATIVE/UNPRODUCTIVE		(1) + (3)	NS

¹ MOOS (1976) SOCIAL CLIMATE FACTORS

* $p < .05$

NS - differences between group means non-significant

H - Home

W - Work

Perspective in both environments with the exception of Verbal Originality at home. The creative/unproductive group were superior on this.

UNCREATIVE/PRODUCTIVE

Performance was consistently lower than the other self-concept groups on TTCT measures, although their performance tended to improve in the work environment and in fact they obtained the highest mean score on Articulateness.

Self-concept classification of creativity was highly accurate for all 3 groups in terms of TTCT performance. It appears that abilities involved in Verbal divergent thinking are more strongly associated with a self-concept as productive, as well as creative. In an academic setting, verbal ideational fluency and flexibility would be anticipated to be more strongly associated with creative production, at least theoretically. Although the creative/productive group among the academic staff did not differ significantly from the creative/unproductive group in terms of publications, the distribution was skewed towards a higher number of publications. For a proportion of subjects then, who hold a self-concept as creative/productive, verbal divergent thinking abilities are associated with productivity and these individuals validly assess their own creative abilities and productivity. For this group and the creative/unproductive group, merely asking them to evaluate their creativity and productivity is a moderately reliable method of assessment.

A stepwise discriminant analysis was performed for

the self-concept groups which included demographic, creativity scale and cognitive style variables as discriminators, in order to assess the relative contribution of these factors to self-concept. The results appear in Table 3. Function 1 provided a degree of separation between these groups which was just short of statistical significance. The dimension separated the creative/productive from the creative/unproductive group most clearly. It is interesting to note that the Taylor's BDS scale is negatively related while the CPS creativity scale is related in a positive direction to a creative/productive self-concept. A higher level of education most strongly separates this self-concept group from those who see themselves as creative but unproductive.

Function 2 adds some further degree of separation, although non-significant, between creative/unproductive and uncreative/productive. There is considerable overlap on this dimension between the "productive" groups (creative and uncreative). Classification of subjects in terms of these dimensions was moderately successful (55.1% correct). Accuracy of classification was optimal for the "productive" groups: 59.5% creative/productive, 59.1% uncreative/productive. Only 12.5% of the creative/unproductive group were correctly classified by these variables.

The creativity measures were of most importance in identifying creative/unproductive subjects, particularly CPS scale, while education, age and cognitive style variables were more important in identifying a productive

TABLE 3
DISCRIMINANT FUNCTION COMPOSITION - VARIABLES
SEPARATING SELF-CONCEPT GROUPS

INDEPENDENT VARIABLES	STANDARDIZED COEFFICIENTS	FUNCTION	CANONICAL CORRELATION	χ^2	p
Education	.61	1	.49	28.03	.06
GCIQ	-.48				
Age	.45				
Information access to original research	.38				
Taylor's BDS total	-.36				
CPS	.24				
CPS	.91	2	.34	10.37	.40
Taylor's BDS total	.52				
Age	-.16				
Education	-.14				
Information access to original research	.04				

self-concept.

4. VALIDITY OF "INFORMATION SEEKING BEHAVIOUR"

Kasperson's (1978) behavioural variables of information seeking behaviour were not related to the creativity scales, cognitive style variables (e.g. imagery ability, Janusian thinking) or to creative performance on the TTCT. However, the dimension of 'access to original research' did contribute significantly to identification of subjects perceiving themselves as creative/productive (Table 3). These results offer some support for Kasperson's findings with a scientist sample and convergent validation for self-concept assessment compared to peer evaluation of creative productivity. However, information seeking behaviour was generally not associated with other creative abilities and its predictive utility in creative thinking appears limited to a specific form of creative productivity.

5. VALIDITY OF 'RAPID OPPOSITE RESPONDING' (JANUSIAN THINKING)

Opposite responding tendency (ORT) was significantly related to VVIQ ($r = .21$, $p = .05$). When the criterion of response latency was added, for defining rapid opposite responding (ROR) the difference between rapid opposite responders and opposite responders in terms of vividness of imagery was just short of significance ($p = .06$). A tendency to respond in word associations with opposites, is

associated with vivid visual imagery and this is more pronounced with rapid opposite responding. Paivio (1971) commented that imagery as a mediator may speed up transformational thinking. From those results it appears that Janusian thinking, defined as simultaneous conceptualization (Rothenberg, 1973a) is associated and enhanced with imaging processes even when input/output mode is verbal. Control of visual imagery was not related to ORT but there was a difference between ROR and ORT groups which approached significance ($p = .08$). Janusian thinkers tend to have less controlled or more autonomous visual imagery as well as more vivid. The difference in control of imagery was largely associated with the subfactors of GCIQ Color and Movement.

ORT and ROR were not associated with the creativity scales (CPS, BDS, Holmes). Although self-concept and ROR were not significantly associated (X^2) there was a noticeable trend for rapid opposite responders to classify themselves as creative (69%), either creative/productive or creative/unproductive. In TTCT performance, both ORT and ROR were significantly associated with Figural divergent thinking (fluency, originality), Internal visual perspective, Breaking boundaries in the home environment ($p < .05$) and with Verbal divergent thinking in the work environment.

Commonality scores in the word association task were more consistently predictive of Verbal divergent thinking than ORT or ROR with significant negative correlations occurring in both environments ($p < .05$) i.e. uncommon word

associating was related to higher scores on Verbal divergent thinking. Prediction of performance on TTCT tasks is improved by ROR measurements over associative originality measurement, only in the figural mode. If visual imagery is a strong mediator in Janusian thinking, an enhancement effect in figural divergent thinking for individuals demonstrating this cognitive ability is not surprising.

6. EFFECT OF INSTRUCTIONS TO 'BE CREATIVE'

Instructions to 'Be Creative' significantly improved performance on Verbal divergent thinking (Total score for Fluency, Flexibility, Originality) in the work environment ($p = .003$). Significant main effects for instructional set were also obtained for two criterion measures of figural performance, also in the work environment, but the direction of effect was reversed. For Combination of Repeated Figures and Unusual Visual Perspective, the 'Be Creative' instruction group obtained lower scores ($p = .03$).

a. DIFFERENTIAL EFFECT FOR HIGH AND LOW CPS

The distribution of CPS scores was divided into thirds to replicate Harrington's (1975) analysis. Analysis of variance yielded no significant differences in TTCT performance between these groups.

Subsequently, the distribution was divided into two groups, High and Low CPS, at the sample mean ($M = 40$, standardized score). Instructional group significantly interacted with CPS group ($p = .05$) only for performance on

three figural criterion measures: Movement, Combination of Repeated Figures and Unusual Visual Perspective. However the effect was inconsistent, with instructions to 'Be Creative' enhancing Movement scores for High CPS but suppressing scores on the latter two measures. Instructions did not alter performance for High CPS on other TTCT measures.

For Low CPS subjects, instructions to 'Be Creative' significantly improved performance on Verbal divergent thinking (Fluency, Originality) and on several criterion measures of figural performance (Titles, Articulateness, Internal Visual Perspective) ($p < .05$). This occurred in the work environment only. Even with the enhancing effect of instructions, Low CPS obtained consistently lower scores on Verbal divergent measures than High CPS. Harrington's (1975) results for a differential effect of instructions with High and Low CPS scores, were not supported in the present study.

b. DIFFERENTIAL EFFECT OF INSTRUCTIONS FOR SELF-CONCEPT GROUPS

Creative/Productive

A facilitating effect occurred with subjects classifying themselves as creative/productive, in the work environment only, when instructed to 'Be Creative'. A significant difference between instructional groups was obtained for Verbal divergent thinking ($p = .04$), Movement ($p = .04$) Colorfulness of Imagery ($p = .05$) and Internal Visual Perspective ($p = .02$).

Creative/Unproductive

An enhancement effect occurred for Figural divergent Thinking and Feeling, in the home environment. However the difference was short of significance.

Uncreative/Productive

For those subjects who classified themselves as uncreative/productive, instructions to 'Be Creative' suppressed performance in the work environment on Figural divergent thinking ($p=.05$), Unusual Visual Perspective, Feeling and Resistance to Premature Closure ($p=.06$).

The results from self-concept classification indirectly support Harrington's (1975) proposition that instructions to be more creative are threatening to individuals who perceive themselves as uncreative and consequently interferes with their performance. This occurred particularly in the work environment which these subjects rated in very negative terms (see results for environmental differences, Table 2). It is conceivable that the combination of self-doubt or insecurity engendered by the demand for novelty, in addition to the negative perception of the work environment contributed to lower performance level.

7. ENVIRONMENTAL DIFFERENCES IN TTCT PERFORMANCE

From the sample data, performance on the normed TTCT measures was significantly related between the two environments (Table 4). Comparing the correlation

TABLE 4

CORRELATIONS BETWEEN HOME AND WORK PERFORMANCE ON TTCT NORMED MEASURES
- INFLUENCE OF CPS AND INSTRUCTION CATEGORY

TTCT Subtest	Across Sample	Low CPS			High CPS		
		Total Group	Normal Instructions	Be Creative Instructions	Total Group	Normal Instructions	Be Creative Instructions
Verbal fluency	.76**	.79**	.89**	.69**	.69**		.92**
Verbal flexibility	.69**	.69**	.67**	.63*	.68**		.82**
Verbal originality	.74**	.81**	.91**	.69**	.58*		.82**
Figural fluency	.53**	.69**	.71**	.75**			
Figural originality	.51**	.69**	.76**	.67*			
Figural titles	.28*	.38*		.49*			
Figural elaboration	.57**	.60**	.51*	.66*	.59*	.88**	
Resistance to premature closure	.36*	.47*	.50*				

* $p < .05$

** $p < .005$

coefficients to test-retest reliability coefficients cited by Torrance (1980) with varying samples, the magnitude of coefficients from the present study is considerably lower, suggesting an environmental influence. When intercorrelations between subtests are examined, in each environment (Table 5) an environmental influence on consistency in performance is evident only for figural subtests.

In order to clarify the influence of environmental differences in creative performance inter- and intra-situational variability was examined separately for High and Low CPS scorers as these groups had already demonstrated differential response to experimental manipulation of instructions (current study and Harrington, 1975).

1. High CPS - High CPS scorers as a group demonstrated greater variability in performance between the two environments. Although inter-situational correlations were significant for Verbal divergent thinking measures, the magnitude of the relationship was lower than Low CPS and there was no relationship between situations for figural performance apart from Elaboration (Table 1). High CPS subjects performed better in the home environment; they scored significantly higher on Verbal divergent thinking and Unusual Visual Perspective ($p < .05$) than Low CPS, at home, but there was no difference between these groups in the work situation. Intra-subject consistency in performance within each situation was also better for High CPS in the home (Table 6). However, instructional set had a strong

TABLE 5

INTERCORRELATIONS BETWEEN TTCT NORMED SUBTESTS AT HOME AND WORK - ACROSS SAMPLE

HOME	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Verbal fluency (1)		.90**	.89**	.45**	.51**	.36**	.30*	.23*
Verbal flexibility (2)			.84**	.47**	.56**	.35**	.40**	.26*
Verbal originality (3)				.39**	.47**	.38**	.36**	-
Figural fluency (4)					.87**	.30*	.28*	.46**
Figural originality (5)						.34*	.46**	.44**
Figural titles (6)							.50**	.61**
Figural elaboration (7)								.39**
Resistance to premature closure (8)								

WORK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Verbal fluency (1)		.90**	.92**	.27*	.34**	.40**	.33**	.25*
Verbal flexibility (2)			.84**	-	.23*	.39**	.27*	-
Verbal originality (3)				.26*	.30*	.47**	.30*	.26*
Figural fluency (4)					.79**	.21*	.27*	.43**
Figural originality (5)						.24*	.36**	.42**
Figural titles (6)							.32*	.39**
Figural elaboration (7)								.33**
Resistance to premature closure (8)								

* $p < .05$ ** $p < .005$

modifying influence on environmental differences for the High CPS group. Instructions to 'Be Creative' considerably enhanced inter-situational stability in performance for Verbal tasks (Table 4) and improved intra-situational consistency in performance across Verbal and Figural tasks (Table 6). Again, the effect was stronger in the home environment. The intercorrelations between TTCT subtests in the home environment, and especially with 'Be Creative' instructions, are substantially stronger than previously reported interrelationships (Torrance, 1974; Torrance & Ball, 1980).

2. Low CPS - The Low CPS group demonstrated significant relationships between environments, on all TTCT subtests (Table 4). However the effect of instructions to 'Be Creative' lowered the strength of the relationships due to some individuals decreasing performance level with 'Be Creative' instructions (from examination of data plots). Inter-situational stability was still relatively strong. The effect of instructions on intra-subject performance within situations, was moderate (Table 7), although 'Be Creative' instructions in the work environment resulted in less consistent performance among subtests.

3. Perception of Home and Work environments. High CPS perceived their home environment, where their TTCT performance was superior, in a manner which would appear more conducive to creativity according to previous literature (e.g. Taylor, 1972). They rated control in the home significantly lower than Low CPS ($p = .005$) i.e. less rigid rules, greater freedom in behaviour, and a higher degree of expressiveness, spontaneous communication and intellectual-cultural orientation, although the latter two

TABLE 6
INTERCORRELATIONS BETWEEN TTCT SUBTESTS AT HOME & WORK FOR HIGH CPS
FOR EACH INSTRUCTION GROUP

NORMAL INSTRUCTIONS									BE CREATIVE INSTRUCTIONS								
HOME	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Verbal Fluency (1)		.92**	.89**							.95**	.95**		.88**				
Verbal Flexibility (2)			.85**								.91**	.54*	.87**				
Verbal Originality (3)												.60*	.96**				
Figural Fluency (4)					.85**								.78**				
Figural Originality (5)							.65*										
Figural Titles (6)							.63*	.71*							.74*	.91**	
Figural Elaboration (7)								.67*								.59*	
Resistance to Premature Closure (8)																	

WORK																	
Verbal Fluency (1)		.79**	.92**							.96**	.97**					.48*	
Verbal Flexibility (2)			.88**								.95**					.52*	
Verbal Originality (3)																.49*	
Figural Fluency (4)													.97**			.50*	
Figural Originality (5)																.56*	
Figural Titles (6)								.51*								.49*	
Figural Elaboration (7)																	
Resistance to Premature Closure (8)																	

* $p < .05$
** $p < .005$

TABLE 7
INTERCORRELATIONS BETWEEN TTCT SUBTESTS AT HOME & WORK FOR LOW CPS
FOR EACH INSTRUCTION GROUP

		NORMAL INSTRUCTIONS								BE CREATIVE INSTRUCTIONS							
HOME		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Verbal Fluency	(1)		.68**	.86**	.55*	.48*	.46*			.97**	.89**	.44*	.49*	.51*	.64**	.52*	
Verbal Flexibility	(2)			.69**	.52*	.57*		.45*	.38*			.92**	.42*	.47*	.53*	.63**	.46*
Verbal Originality	(3)				.47*									.43*	.56*	.64**	.42*
Figural Fluency	(4)					.92**	.39*		.60**					.94**			.53*
Figural Originality	(5)								.55*							.53*	.47*
Figural Titles	(6)							.40*	.69**							.51*	
Figural Elaboration	(7)																.40*
Resistance to Premature Closure	(8)																
WORK																	
Verbal Fluency	(1)		.91**	.93**	.42*		.59**	.41*	.39*	.79**	.87**			.50*	.61*	.44*	
Verbal Flexibility	(2)			.83**	.36*		.55**	.43*			.57*			.55*			.49*
Verbal Originality	(3)				.38*		.61**	.41*	.39*					.47*	.77**		
Figural Fluency	(4)					.83**			.59**					.81**			.47*
Figural Originality	(5)						.39*	.52*							.42*		
Figural Titles	(6)						.59**	.42*							.49*	.64**	
Figural Elaboration	(7)							.52*								.66**	.66**
Resistance to Premature Closure	(8)																

* $p < .05$
** $p < .005$

were nonsignificant. In the work environment High CPS rated acceptance of innovation lower, but the difference was not significant. Kilmann, Pondy & Slevin (1976) found that the attitude or perception of work organizations as open to innovation, was a more important predictor of creativity than structural variables of organization. The present results offer some support for this.

Some general conclusions from these results:

1. Verbal divergent thinking appears much more stable for all subjects, and less influenced by situational or attitudinal influences than figural performance.

2. High CPS scorers are superior in divergent thinking than Low CPS, further validating the CPS scale as a measure of creativity, however their performance is more variable and they appear more vulnerable to environmental influences and motivational influences. Perception of the environment as facilitative to creativity seems to be influential. The question is raised but not answerable in this study, whether highly creative people, as identified by the CPS, seek out or create these facilitative conditions.

8. PREDICTIVE VALIDITY OF CREATIVITY SCALES: DIRECT AND INDIRECT SELF-CONCEPT MEASURES

a. RELATIONSHIP BETWEEN MEASURES

The Creative Person Scale was significantly related to the Holmes Questionnaire (Table 8) however shared no variance with BDS total or subscales. Several of the subscales were moderately but significantly related to the HQ but the relationship became nonsignificant for the total

TABLE 8

A. INTERRELATIONSHIPS BETWEEN BDS SUBSCALES

B. RELATIONSHIPS BETWEEN DIRECT AND INDIRECT CREATIVE SELF-CONCEPT MEASURES -
CPS, HQ, BDS Total and Subscales

	CPS	HQ	BDS total	(1)	(2)	BDS Subscales		(5)	(6)	(7)	(8)	(9)	(10)
						(3)	(4)						
CPS		.58**	-	-	-	-	-	-	-	-	-	-	-
HQ			(.20)	.30*	-	.31*	-	-	-	-	.28*	.32*	.30*
BDS Total													
Person (1)					.65**	.68**	.68**	.36*	.73**	.57**	.69**	.69**	.73**
Process (2)						.78**	.78**	.34*	.47**	.53**	.76**	.87**	.85**
Problems (3)							.85**	.51**	.67**	.62**	.87**	.86**	.87**
Products (4)								.57**	.65**	.71**	.86**	.84**	.86**
Climate (5)									.49**	.54**	.67**	.53**	.54**
Expressive (6)										.40**	.59**	.53**	.58**
Technical (7)											.56**	.53**	.53**
Inventive (8)												.86**	.88**
Innovative (9)													.94**
Emergentive (10)													

* $p < .05$ ** $p < .005$ () $p < .1$

BDS score.

The CPS and HQ measures were administered prior to receiving instructions for TTCT completion, however the BDS was administered following TTCT tasks. Although the instructional condition related specifically to TTCT performance it was considered possible that awareness of the focus on 'creativity' may have confounded BDS ratings as it is a direct measure of creative self-concept. However, analysis of variance yielded no significant effect for instruction group on BDS total or subscales.

b. PREDICTION OF TTCT PERFORMANCE

Creative Person Scale

The CPS was only significantly related to Verbal divergent thinking subtests in a positive direction (Table 9) and to Combination of repeated figures in the figural tasks. Significant negative relationships occurred with two of the figural criterioned measures. Instructions to 'Be Creative' resulted in non-significant relationships with all TTCT measures except for Resistance to premature closure. The relationship here changed from negative to positive with instructions to 'Be Creative'.

Inconsistency cross-situationally occurred. The CPS was not predictive of performance in the work environment.

Table 9
Correlations between Creative Person Scale (ACL) and
Torrance Tests of Creative Thinking for each Instruction
Group

Torrance Subtests		Instruction Group			
<u>Home Performance</u>		Normal		Be Creative	
Verbal Fluency	$r = .29$ $p = .04$			$r = .21$ $p = .15$	
Verbal Flexibility	.42	.01		.19	.19
Verbal Originality	.28	.08		.27	.09
Figure Titles	- .05	.40		.29	.07
Resistance to					
Premature Closure	- .39	.02		.33	.05
Movement	- .52	.003		.17	.20
 <u>Work Performance</u>					
Combination Repeated					
Figures	.33	.03		- .25	.11
Internal Visual					
Perspective	- .27	.06		- .27	.09

(Only the Torrance subtests which yielded significant or approaching significant correlations in at least one group are reported).

Holmes Questionnaire

Significant relationships occurred between the HQ and both Verbal and Figural measures. This scale was also significantly related to a number of the criterioned measures of figural performance e.g. Resistance to premature closure, Unusual visual perspective, Breaking boundaries (Table 10). Prediction for Verbal divergent thinking was strengthened with instructions to 'Be Creative'. The apparent enhancement of performance was most noticeable in the home environment. The magnitudes of correlational coefficients with the optimizing effect of instructional set are somewhat stronger than generally reported between creativity scales and divergent thinking performance. Figural performance does not appear to be enhanced by the experimental manipulation of instructions and in the work environment instructions appear to have suppressed performance for some individuals.

Taylor's BDS

In the normal instruction group, significant correlations between BDS subscales and TTCT performance were virtually all negatively related, directly contradicting the construct validity of the BDS and not supporting Taylor's (1973, 1976) findings. The BDS did not predict Verbal divergent thinking performance in either environment. The Person subscale particularly appeared to have no predictive utility for performance on TTCT tasks, (Table 11).

Instructions to 'Be Creative' altered the pattern of relationships dramatically (Table 12) resulting in significantly positive relationships between the majority of

Table 10

Correlations between Holmes Questionnaire and Torrance Tests
of Creative Thinking for each Instruction Group

Torrance Subtests	Instruction Group			
	Normal		Be Creative	
Home Performance				
Verbal Fluency	r = .29	p = .07	r = .53	p = .002*
Verbal Flexibility	.26	.09	.48	.006*
Verbal Originality	.28	.08	.49	.004*
Figural Fluency	.34	.04*	.21	.14
Figural Originality	.41	.02	.37	.03 *
Resistance to Premature Closure	- .07	.37	.41	.01 *
Unusual Visual Perspective	.15	.23	.31	.05 *
Breaking Boundaries	.28	.08	.32	.05 *
Work Performance				
Verbal Fluency	.39	.01*	.40	.02 *
Verbal Flexibility	.39	.01*	.40	.02 *
Verbal Originality	.36	.02*	.47	.007*
Figural Fluency	.31	.03*	- .04	.42
Figural Originality	.32	.03*	.004	.49
Figural Titles	.27	.06	.01	.48
Expressiveness of Titles	.28	.06	- .02	.45
Combination of Repeated Figures	.31	.04*	- .03	.44
Richness of Imagery	.02	.45	- .37	.03 *

(Only the Torrance subtests which yielded significant or approaching significant correlations in at least one group are reported).

TABLE 11

¹CORRELATIONS BETWEEN TTCT SUBTESTS AND TAYLOR'S BDS SUBSCALES ACROSS SAMPLE
- NORMAL INSTRUCTION GROUP

TTCT Subtests	TAYLOR'S BDS									
	Person	Problem	Process	Product	Climate	Expressive	Technical	Inventive	Innovative	Emergentive
<u>HOME</u>										
Figural fluency								.41*		.37*
Figural elaboration	-.41*	-.39*	-.51*			-.51*	-.42*			(-.34)
Resistance premature closure	-.37*						-.39*			-.42*
Feeling	-.46*	-.36*					-.37*			(-.33)
Articulateness	-.47*	-.41*	-.40*			-.42*	-.46*			
Fantasy		-.35*	-.38*			-.39*				
<u>WORK</u>										
Figural originality		-.45*	-.41*			-.63**				
Figural titles		(-.32)								
Figural elaboration								(-.35)		
Resistance premature closure	-.35*	-.40*	-.44*			-.50*				
Feeling	-.48*	(-.33)					-.37*			-.35*
Articulateness			-.35*							
Movement	-.35*									
Expressiveness of titles		-.41*								
Combination repeated figures		.41*								.36*
Unusual visual perspective					-.35*					
Breaking boundaries					(.33)		.37*			
Richness of imagery							-.38*			
Colorfulness of imagery	-.43*	-.42*		-.39*	-.43*		-.38*			

* p < .05
** p < .005
() p < .06

¹only significant or approaching significant results are reported

TABLE 12
¹ CORRELATIONS BETWEEN TTCT SUBTESTS AND TAYLOR'S BDS SUBSCALES ACROSS SAMPLE
 - BE CREATIVE INSTRUCTION GROUP

TTCT Subtests	TAYLOR'S BDS								
	Person	Problem	Process	Product	Climate	Expressive	Technical	Inventive	Innovative Emergentive
HOME									
Verbal fluency	.43*				.45*			.53*	.53* .45*
Verbal flexibility	.45*	.37*			.45*			.55*	.54* .47*
Verbal originality								.47*	.42* (.35)
Figural fluency								.41*	
Figural originality			.48*	.39*	(.36)			.57**	.49* .47*
Figural elaboration		(.36)	.43*	(.37)	(.36)			.45*	.43* .44*
Feeling	-.40*	-.49*	-.38*		-.48*			-.50*	-.45* -.48*
Unusual visual perspective		.50*							
Colorfulness of imagery								.38*	.38*
WORK									
Verbal fluency					.57**			.40*	
Verbal originality					.46*			(.35)	
Articulateness						.45*			
Movement						.38*			
Combination repeated figures		.38*	.50*					.48*	.44* .42*
Unusual visual perspective		.44*	.58**	.57**	.36*	.43*	.37*	.50*	.56** .57**
Breaking Boundaries	(.35)		(.35)	(.35)		.39*		.40*	.42*
Humor	(.36)		.39*	.60**	.44*	.42*		.58**	.45* .47*
Colorfulness of imagery				.38*		.42*			

* $p < .05$
 ** $p < .005$
 () approaching significance $p < .06$

¹ only significant or approaching significant results are reported

BDS subscales and a wider range of TTCT subtests, including Verbal divergent measures. Again, the Person scale was of little predictive value nor was the Technical subscale. The magnitude of correlations were similar in strength to the HQ and the BDS also paralleled the HQ in the lack of relationship to figural divergent performance in the work environment. The predictive utility of the BDS surpassed the HQ for the criterion measures of figural performance in the work situation, with the optimizing effect of instructions to 'Be Creative'.

1. Differential prediction for High and Low CPS groups

The predictive utility of the BDS in TTCT performance was examined separately for High and Low scorers on the CPS as these groups have been shown to differ in the variability of their performance. Consequently, one might expect the predictive utility of a creativity scale to differ as well.

For the Low CPS group the pattern of relationships between the BDS and TTCT was similar to that found across the sample. 'Be Creative' instructions tended to produce nonsignificant relationships (Tables 13, 14) or strengthened negative relationships, apart from the BDS Problem subscale which was positively related to a number of TTCT measures. If the effect of this instructional set was to decrease the level of performance for Low CPS subjects, as previously suggested, this would account for the variation in BDS prediction.

High CPS subjects, in the normal instruction group, demonstrated few significant relationships between BDS and

TABLE 13

¹CORRELATIONS BETWEEN TTCT AND TAYLOR'S BDS SUBTESTS FOR LOW CPS SCORERS IN NORMAL INSTRUCTION GROUP

TTCT Subscores	TAYLOR'S BDS							
	PERSON	PROBLEM	PROCESS	PRODUCT	CLIMATE	EXPRESSIVE	TECHNICAL	INVENTIVE
HOME								
VERBAL FLUENCY						-.49*		
VERBAL FLEXIBILITY		-.51*				-.62*		-.43*
FIGURAL ORIGINALITY		-.53*			-.49*	-.48*		
FIGURAL ELABORATION		.51*		-.57*				
RESISTANCE TO PREMATURE CLOSURE	-.56*	-.52*				-.56*		-.55*
FEELING	-.60*	-.44*	-.45*					-.47*
ARTICULATENESS	-.45*	(-.41)				-.57*	(-.40)	
MOVEMENT	-.64**	-.64**	-.52*			-.65**		-.55* - .71**
COMBINATION REPEATED FIGURES		-.63*	-.56*			-.61*	-.46*	
INTERNAL VISUAL PERSPECTIVE	-.61*						-.45*	-.43*
RICHNESS OF IMAGERY		-.55*	-.48*		-.62*			
COLORFULNESS OF IMAGERY	-.60*	-.42*	-.47*			-.59*	-.51*	
FANTASY	-.45*							
WORK								
FIGURAL FLUENCY		-.55*			-.74**			
FIGURAL ORIGINALITY		-.58*			-.69**	-.65*		
FIGURAL TITLES	-.49*	-.58*					-.49*	
RESISTANCE TO PREMATURE CLOSURE	-.63*	-.69**	-.48*		-.57*	-.63*	-.59*	
ARTICULATENESS		-.45*						
INTERNAL VISUAL PERSPECTIVE	.48*							
BREAKING BOUNDARIES				(.42)				
COLORFULNESS OF IMAGERY				-.49*	-.45*			

* $p < .05$
 ** $p < .005$
 () approaching significance $p < .06$

¹ only significant or approaching significant correlations are reported

TABLE 14

¹CORRELATIONS BETWEEN TTCT AND TAYLOR'S BDS SUBTESTS FOR LOW SCORERS IN BE CREATIVE GROUP

TTCT Subscores	TAYLOR'S BDS						
	PERSON	PROBLEM	PROCESS	PRODUCT	CLIMATE	EXPRESSIVE	TECHNICAL
HOME							
VERBAL FLUENCY	.50*						
VERBAL FLEXIBILITY	.50*						
RESISTANCE TO PREMATURE CLOSURE	(.49)						
FEELING					-.56*	(.48)	
EXPRESSIVENESS TITLES	-.43*				-.53*		-.51*
BREAKING BOUNDARIES	.58*						
FANTASY	.52*			.53*		.53*	(.49)
WORK							
VERBAL FLEXIBILITY	-.57*			-.55*		-.61*	
RESISTANCE TO PREMATURE CLOSURE	(.51)						
FEELING			-.71**	-.58*		-.64*	-.62*
COMBINATION REPEATED FIGURES			.56*				
UNUSUAL VISUAL PERSPECTIVE	.54*						
HUMOR	.57* (.51)			.63*		.63*	.70** .63*

* $p < .05$
 ** $p < .005$
 () approaching significance $p < .06$

¹ only significant or approaching significant correlations are reported

TTCT subscales and this was more marked in the work environment. The greater variability in performance of these subjects would be anticipated to decrease the predictive utility of a self-concept measure. However the pattern of significant positive relationships differed not only in the subscales involved but in the magnitude of the relationships which were substantially higher than usually obtained between creativity scales and performance (Table 15). Particularly notable is the very strong prediction of Figural divergent thinking, in the home environment, from the Person scale which has been of little utility with other subject groups.

The effect of 'Be Creative' instructions was to increase prediction of Verbal divergent thinking especially in the home situation (Table 16). This parallels the effect of instructions on the predictive validity of the HQ. Situational influences on prediction from BDS scales was most apparent for the criterion measures of figural tasks. While in the home situation negative relationships occurred, the same TTCT measures were significantly positively related in work performance, to BDS scales.

The complexity of these results for High CPS subjects makes interpretation a rather horrendous task. Firstly, there was no difference between High and Low CPS groups on BDS scores, in fact group means were virtually identical. However, previously reported results demonstrated High CPS subjects were superior on a number of measures associated with creative performance which suggests that their self-assessment on the BDS was more accurate. Consequently,

TABLE 15

¹CORRELATIONS BETWEEN TTCT AND TAYLOR'S BDS SUBTESTS FOR HIGH CPS SCORERS IN NORMAL INSTRUCTION GROUP

TTCT Subscores	TAYLOR'S BDS						
	PERSON	PROBLEM	PROCESS	PRODUCT	CLIMATE	EXPRESSIVE	TECHNICAL INVENTIVE INNOVATIVE EMERGENTIVE
HOME							
VERBAL FLUENCY						-.66*	
VERBAL FLEXIBILITY							.68*
VERBAL ORIGINALITY						-.69*	
FIGURAL FLUENCY	.92**	.80*					.65*
FIGURAL ORIGINALITY	.83*	.77*					
FIGURAL TITLES	.83*						
MOVEMENT COMBINATION	-.67*			-.83*		-.89**	-.74*
REPEATED FIGURES				-.68*		-.79*	
UNUSUAL VISUAL PERSPECTIVE				-.65*			
WORK							
FIGURAL FLUENCY		.66*				.60*	
FIGURAL ORIGINALITY				-.63*			-.66*
COLORFULNESS OF IMAGERY		-.62*					
FANTASY		-.62*					

* $p < .05$, ** $p < .005$
 () approaching significance $p < .06$

¹ only significant or approaching significant results are reported

the extreme variations in prediction from the BDS appear to be due to High CPS subjects' variability in performance. The apparent invalid self-assessment of the Low CPS i.e. overestimation of their creativity on the BDS, would result in the negative relationships found with performance.

c. WORD ASSOCIATION TASK

Both the HQ and the CPS were significantly related to Commonality i.e. high scorers on these scales tended to give more original associations ($p = .03, .02$ respectively). Only the HQ was associated with the tendency to give opposites in responding ($p = .03$). Neither the HQ or CPS was significantly related with Rapid Opposite Responding, although HQ approached significance ($r = .17, p = .08$). The BDS total and subscales demonstrated no relationship to performance on the word association task.

d. SUMMARY AND DISCUSSION

The fairly substantial degree of shared variation between the CPS and the HQ is encouraging in offering convergent validation for individual differences in creative self-concept. Although a degree of association would be anticipated as the HQ includes some adjective descriptors from earlier versions of the CPS (Holmes, 1976), the strength of the relationship found exceeds this consideration. The two direct measures of creative self-concept (HQ and BDS) were less strongly related

although the degree of association with several BDS subscales is similar to that found between creativity measures generally, around .30. The timing of administration of these scales (pre- and post-TTCT completion) may have lowered the strength of relationship. However the utility of direct enquiry concerning subjects' creative abilities and potential is supported by the present results.

The CPS demonstrates limitations as a predictive tool for the range of creative cognitive processes measured. Although the correlations with verbal performance on the divergent thinking tasks were statistically significant in one environment and of similar magnitude to previous findings with a range of creative performance criteria (Gough & Heilbrun, 1980), the relationships were unstable cross-situationally and vulnerable to instructional set. Contrary to Harrington's (1975) results using the CPS, instructions to 'Be Creative' decreased the strength of relationship between this scale and divergent thinking performance.

The HQ appears a more reliable and valid instrument for predicting the range of cognitive processes involved in two modes of divergent thinking tasks as well as "Janusian Thinking" as operationally defined by Rothenberg (1973). Motivational (instructions) and environmental factors enhanced predictive power for verbal divergent performance and a number of figural criterion measures but had little effect on figural divergent thinking. It appears that verbal performance is more vulnerable to internal and

external influences, supporting previous results from this study. These results emphasize the crucial need to elucidate optimizing testing conditions by further research, particularly for verbal performance. Verbal divergent tasks have been favoured in previous studies; the evident variability must partially account for the inconsistency of results.

When the predictive utility of the BDS was examined, across the sample, the validity of this measure in predicting creative cognitive processes involved in the present study, appeared undermined by the consistently significant negative relationships. However 'Be Creative' instructions reversed the direction and resulted in a parallel pattern to the HQ in terms of differential prediction for Verbal and Figural tasks and environmental influences. There was no relationship with the variables measured in the word association task.

Separating High and Low CPS groups resulted in extensive inconsistency and complexity for the predictive validity of the BDS subscales, between CPS groups, instructional sets, environments and TTCT tasks. At first glance, this seems to decrease the validity of the BDS as a predictive instrument of creative performance, relative to the HQ. However, the strength of the relationships obtained under the various conditions, with specific subscales, far exceeded previous findings from the present study or the literature. As the fluctuations seemed to be partially a result of invalid self-ratings of Low CPS subjects, possibly from the timing of BDS completion, it was considered that

the BDS may still have potential to surpass the other self-concept measures, in predictive power.

In order to test this, the BDS scale and scoring system was revised in an attempt to maximize prediction, improve consistency and decrease redundancy of information obtained in the range of BDS subscales. The latter goal was based on observation of the strong interrelationships between some of the subscales (Table 1). Subscales were selected which had the strongest correlations with the majority of TTCT measures and the greatest consistency cross-situationally for each CPS group. This resulted in 3 shared subscales (Emergentive, Expressive, Technical) and for High CPS subjects, the Person scale. Low CPS subjects would be scored separately for the Inventive scale. The revised BDS was utilized in a later experiment to assess predictive validity (see results for Experiment 3).

Effect of instructions

Although Harrington's (1975) findings of the effect of instructions on divergent thinking performance were not supported for the CPS, in the present study, some support was offered from the results with the HQ and BDS. Instructions to 'Be Creative' led to strengthened linear relationship between the HQ, BDS and Verbal divergent performance only in the home environment. For some Low CPS scorers, instructions appeared to suppress performance resulting in nonsignificant or strengthened negative relationships between BDS and TTCT.

9. UTILIZATION OF VISUAL IMAGERY IN PERFORMANCE

a. RESULTS

Test-retest reliability of the VVIQ was of similar magnitude to that previously found over an equivalent time period (Westcott & Rosenstock, 1976). Pearson coefficients for Eyes Open, Eyes Closed and Total were .85, .77, .86 respectively ($p < .000$). The subscores significantly intercorrelated ($r = .79$, $p < .000$). The 4 factors of the GCIQ were positively interrelated but only correlations between Misfortune and the other 3 factors reached significance. With Movement $r = .63$, $p < .000$, Colour $r = .54$, $p < .000$, Stationary, $r = .53$, $p < .000$. A degree of independence exists between control of these factors within individuals, especially Colour, Movement and Stationary.

Vividness of imagery was not significantly related to any of the GCIQ subfactors but a positive and significant relationship occurred with the total GCIQ score ($r = .34$, $p < .003$). The strength of the relationship varied considerably between High and Low Vividness groups, however. As one would expect, a significant relationship occurred in the Low Vivid group ($r = .49$) but control of imagery was independent from vividness for those who experienced clear, strong visual images.

Statistically significant correlations and those approaching significance, between the imagery measures and the TTCTs are reported in Table 17. Consistent relationships did not always occur in the two environments. However, correlations are reported if they occurred in at least one. A different pattern occurred between the two instruction groups. It is necessary to bear

TABLE 17
CORRELATIONS OF IMAGERY MEASURES WITH TTCT PERFORMANCE FOR EACH INSTRUCTION CATEGORY

TTCT SCORES	NORMAL INSTRUCTIONS						BE CREATIVE INSTRUCTIONS					
	GCIQ FACTORS						GCIQ FACTORS					
	VVIQ	GCIQ	COLOUR	MOVE- MENT	STAT- IONARY	MIS- FORTUNE	VVIQ	GCIQ	COLOUR	MOVE- MENT	STAT- IONARY	MIS- FORTUNE
Verbal Fluency	-	-	.43	-	-	-	-	-	-.48	-	-	-
Verbal Flexibility	-	-	-	-	-	-	-	-	-.42	-	-	-
Verbal Originality	-	-	.40	-	-	-	-	-	-.34	-	-	-
Figural Fluency	-.31	-	-	-	-	-	-	-	-.56	-	-	-
Figural Originality	-	-	-	-	-	-	-	-	-.54	-	-	-
Figural Elaboration	.34	.34	-	-	-	-	-	-	-	-	-	-
Figural Titles	-.38	-	-	-	-	-	-	-	-	-	-	-
Feeling	-	-	-	-	.34	.37	-	-.33	-	-	-	-
Articulateness	-	.52	-	-.47	-	-	-	(.31)	-.33	-	-	-
Movement	-	-	-	-	.39	-	-	-	-	-.33	-	-
Combination Incomplete Figures	.45	-.48	-	-	-	-	-	-	-	-	-	-
Combination Repeated Figures	-	-	-	-.67	-	-.62	-	-	-.62	-	-	-.43
Unusual Visual Perspective	(.31)	-	-	-.39	-	-.47	-	(.31)	-	-	-	-
Internal Visual Perspective	-	-	-	-	-	-	-.38	-.34	-	-	.38	-
Breaking Boundaries	-	-	.41	-	-	-	-	.52	-.39	-	-	-
Humour	-	-	-	-	-	.35	-	-	-.37	-	-	-
Richness of Imagery	-	-	-	-.39	-	-	-	-.41	-	-	-	-
Colourfulness of Imagery	-	-	-	-	-	-	-.34	-	-	-	-	-
Fantasy	-	.37	-	-	-	-	-	-	-.49	-	-	-.41

All correlations $p < .05$ except () indicates $p < .06$

in mind that there was a tendency for those who were instructed to Be Creative to rate the vividness of their imagery slightly higher. However, this bias was not significant.

Some similarities with previous research occurred in the Normal instruction group. Vividness was negatively related to figural Fluency and positively with Elaboration. Total GCIQ was not associated with verbal or figural scores, except Elaboration but the Colour factor was positively related to verbal Fluency and Originality. This would account for previous findings of a relationship between control and verbal divergent thinking. The only consistency across the instruction groups was a positive correlation of imagery control and Articulateness i.e. communicating an idea, putting it in context, and a negative relationship between the control factor Misfortune and Combination of Repeated Figures i.e. the tendency to synthesize (Torrance & Ball, 1980).

In the Be Creative instruction group, not only is there an obvious lack of a predictive relationship between vividness and TTCT measures, the Colour control factor is significantly negatively related to both verbal and figural performance. It appears then that autonomous imagers are utilizing imagery to enhance creativity, with the task demand for novelty and also that some subjects with high control performed more poorly with added constraints on responding.

Analyses of variance (Table 18) with High and Low

TABLE 18

SUMMARY OF ANOVA RESULTS FOR HIGH AND LOW IMAGERY GROUP DIFFERENCES
ON TTCT PERFORMANCE FOR EACH INSTRUCTION GROUP

T T C T	NORMAL INSTRUCTIONS			BE CREATIVE INSTRUCTIONS		
	MAIN EFFECTS		INTERACTIONS	MAIN EFFECTS		INTERACTIONS
	VIVIDNESS	CONTROL		VIVIDNESS	CONTROL	
Verbal Fluency	-	p = .01	-	-	-	p = .08
Verbal Flexibility	-	-	-	-	-	p = .02
Verbal Originality	-	p = .01	-	-	-	-
Figural Fluency	-	p = .06	-	-	-	p = .07
Figural Originality	-	-	-	-	-	-
Figural Titles	-	-	-	-	-	(p = .06)
Figural Resistance to Premature Closure	-	-	-	-	-	p = .02
Combination Repeated Figures	-	p = .05	-	-	-	p = .04
Unusual Visual Perspective	-	-	-	-	-	-

All interactions resulted in superior performance by those High on both Vividness and Control except () which indicates those Low on both were superior.

scorers in the Normal instruction category yielded significant main effects of control with verbal Fluency and Originality, figural Fluency (approaching significance) and Combination of Repeated Figures with the High control group demonstrating better performance. There were no significant differences between High and Low vivid imagers in performance and no significant interactions. However, significant (or just short of significant) interactions occurred in the Be Creative instruction category for verbal Fluency, Flexibility, figural Fluency, Titles, Resistance to Premature Closure and Unusual Visual Perspective. Those high on both imagery dimensions were superior except on Titles where low imagers shone (low on both). This is not surprising as figural Titles is the most conspicuously conceptual/abstract measure in the scoring system. These differences were statistically significant only for the tests completed in the home environment. For those completed at work the pattern was similar but the difference was of lower magnitude.

Contrasting High scorers on figural divergent thinking and verbal, the former group had more vivid visual imagery ($p < .06$) but there was no difference in control of imagery. This supports Forisha's (1978) results.

Influence of Personality Orientation

The relationships found between imagery and TTCT performance were stronger among high scorers than low scorers on Taylor's BDS. For low scorers there were no statistically significant effects. There was no difference between high and low BDS scorers in imagery ability which

suggests that the difference lies in the utilization of imagery in problem-solving rather than introspective awareness.

Creative Self-Concept

The pattern which emerged in the imagery ratings for the four self-categorizations of creativity/productivity (Table 19) demonstrates that vivid imagery separated those who saw themselves as productive. Control of imagery was also associated with a creative self-concept with those who saw themselves as productive rating slightly higher control.

TABLE 19
MEANS OF IMAGERY CONTROL AND VIVIDNESS SCORES FOR
SELF-CONCEPT CATEGORIES

<u>SELF-CATEGORIZATION</u>	<u>G C I Q MEANS</u>	<u>V V I Q MEANS</u>
CREATIVE/PRODUCTIVE	18.8	70.5
CREATIVE/UNPRODUCTIVE	17.8	84.1
UNCREATIVE/PRODUCTIVE	16.6	77.5
UNCREATIVE/UNPRODUCTIVE	-	-

- No subjects categorized themselves as uncreative/unproductive
- All differences were non-significant

b. DISCUSSION

The most apparent conclusion from these results is that the relationship between individual differences in visual imagery and creative performance in ideational fluency tasks is, as Forisha (1978) maintains, far more complex than indicated in the literature. Not only do individuals vary in utilization of imagery, but inconsistencies within individuals occur, influenced by task demands and situational factors. In addition, the use of ideational fluency test totals has obscured the complexity of creative performance with regard to mode of output, cognitive processes involved and qualitative aspects of responses. Similarly a degree of independence between the four factors of imagery control and their differential functional significance points to a need for a more multifaceted approach in the study of visual imagery. The lack of theoretical and empirical work on the control factors makes interpretation of the results obtained, impossible at this stage.

The predictive validity of vividness of imagery was limited to non-verbal performance. Vivid imagery enhanced a qualitative aspect of figural responses i.e. Elaboration, as previously found (Rhodes, 1981), also Combination of Incomplete Figures, which according to Torrance & Ball (1980) taps the ability to break away from the obvious and taking an unusual visual perspective. Control of imagery improves divergent thinking in both verbal and figural modes and this effect is enhanced when imagery is vivid as well. This supports Richardson's (1969) suggestion that vivid, controlled imagery may aid in problem-solving by providing a

means of breaking up an unproductive mental set. However, vivid imagery interferes with some types of verbal abstract processes. Some support is offered for the suggestion by previous writers (e.g. Sheehan, 1972) that autonomous imagery is associated with rigid, stereotyped images, as fluency and originality of ideas was poorer among the subjects. These results can be interpreted as an interference effect of autonomous imagery. It seems reasonable to assume that subjects who score high on vividness but low on control would be similar to Horowitz's (1972) type of imager, experiencing very intense images which are involuntary. Those who score low on both dimensions would be similar to the second type, having difficulty forming visual images much of the time, those that do occur being vague and illusive. The former group, in this study, performed less well than the latter when instructed to be creative but not in the normal situation. If the task demand increased awareness of imagery then it appears that vivid, autonomous imagery did interfere with ideational fluency tasks when the images became more intrusive. The interference effect of vivid, autonomous imagery was greater in the home environment which suggests a situational influence as well, on the salience and intrusiveness of autonomous imagery.

One might hypothesize the home environment to be more relaxed with less demand for focused, analytical thinking which would be conducive to increased awareness of imagery processes. The limited capacity model of interference offers little to aid understanding of these results as the pattern of relationship between imagery and performance was

similar for both verbal and figural responding. However, the verbal form of the TTCT involves some pictorial input which calls into question the inferred distinction between modes of processing.

The congruence of autonomous images experienced with task performance may also be an active influence on whether imagery enhances or interferes, as Paivio (1971) suggests. It would be useful in future investigations to separate the effects by having subjects describe their imagery occurring during problem-solving in terms of vividness, autonomy and congruence.¹

Utilization of imagery in performance was inconsistent cross-situationally as well as being influenced by task demands. The requirement for novelty increased the use of imagery in generating a greater range of responses (fluency) in the figural mode for those with vivid and controlled imagery ability. It also appears to have increased the use of autonomous imagery to enhance some aspects of performance such as emotion, humour and movement expressed in responses. But within this overall pattern, an opposing result occurred for those subjects scoring high on control of the Colour factor specifically. The demand for novelty suppressed their use of imagery in both figural and verbal divergent thinking.

1

vividness and control of imagery relevant to performance during a task were examined in Experiment 3.

Utilization of imagery occurred most consistently amongst the high scorers on the BDS. To some extent this scale measures awareness of cognitive strategies used, preference for innovative work and a dynamic, stimulating climate. BDS scores did not discriminate imagery ability in self-ratings which obviously rules this out as the explanation. The lack of difference in imagery ratings would seem to also negate the significance of introspective awareness, an element of both self-rating measures. It appears then that the functional significance of the BDS in predicting utilization of imagery ability lies in identification of those people who have a creative orientation in cognitive style, personality and lifestyle. Taylor (1976) specifies the interactive nature of a creative orientation, as measured by the BDS, with a direction towards altering one's environment.

The results from the current study support previous research that individual difference measures of imagery have some predictive utility for creative performance on ideational fluency tasks. Prediction improves considerably when the influence of factors such as task demands, situational variables and creative orientation are considered. Prediction would also improve with clarification of the imagery control construct. This would involve identifying and increasing our understanding of the nature of the subfactors which have been demonstrated to have differential functional significance. In addition, separating the type of imagery experienced by subjects who score low on control would enable more precise interpretation of research findings.

10. VALIDITY OF THE REVISED SCORING SYSTEM FOR THE FIGURAL FORM OF TORRANCE TESTS OF CREATIVE THINKING

The revised scoring system for the TTCT which includes two new norm-referenced measures and 13 criterion-referenced measures is based on extensive work by Torrance and colleagues including a long-range predictive study of high school students who were followed up 12 years later. Although the underlying assumptions of the new measures have considerable face validity (Torrance & Ball, 1980; Torrance, 1979) the only empirical validation comes from a study by the author himself, with high school students (Torrance & Ball, 1980) in which the new measures were validated against 3 criteria of creative behaviour: number of creative achievements, ratings of quality of most creative achievements, creativity of future image. Correlations between the criterion measures and the total index of creative behaviour tended to be significant and ranged from low to quite high magnitudes (e.g. .22 - .84). The weakest, including nonsignificant relationships were with the synthesis measure.

The validity of the criterion measures, with an adult population, was examined in relationship to the creativity scales and cognitive style measures used in this study. Table 20 reports correlation coefficients obtained in either environment, for any subgroup of subjects, which were positive and statistically significant. With the BDS, for example, correlations between subscales and TTCT measures ranged from nonsignificant to significant, positive to negative direction across the varying experimental

TABLE 20
CORRELATIONS BETWEEN TTCT CRITERION-REFERENCED MEASURES AND OTHER PERSONALITY/COGNITIVE STYLE
CREATIVITY MEASURES WHICH WERE POSITIVE AND SIGNIFICANT; IN EITHER ENVIRONMENT
OR WITH ANY SUBGROUP OF SUBJECTS

TTCT Measures	CPS	HQ	BDS ¹	WORD ASSOCIATION ORT	ROR	CS	INFORMATION- SEEKING BEHAVIOUR
Feeling	-	-	-	-	-	-	-
Articulateness	-	-	.45 - .71*	-	-	-	-
Movement	-	-	.38 - .58*	-	-	-	-
Expressiveness of titles	-	-	.53 - .60*	-	-	-	-
Unusual visual perspective		.31*	.36 - .87**	-	-	-	-
Internal visual perspective	-	-	.48*	-	.30*	-	-
Humor	-	-	.39 - .74*			.26*	-
Richness of imagery	-	-	.60*	-	-	.22*	-
Colourfulness of imagery	-	-	.38 - .80**	-	-	-	-
Combination of incomplete figures	-	-	-	-	-	-	-
Combination of repeated figures	.33*	.31*	.38 - .71*	-	-	-	-
Breaking boundaries	-	.32*	.37 - .77*	.23*	-	-	-
Fantasy	-	-	.49 - .79**	-	-	.23*	-

* $p < .05$

¹ ** $p < .005$

¹ the lowest and highest significant positive correlation with any BDS subscale are reported

conditions and subject groups. The lowest and highest coefficients reported indicate the range but it is important to remember that the relationships were inconsistent. However, if strong correlations are obtained under at least some conditions, this offers some convergent validation for the criterion measures. Correlations above .60 were usually obtained for the high CPS group.

The evidence for several of Torrance's (1979) propositions are discussed below:

1. It has been suggested that extensive elaboration of ideas may be to the detriment of ideational fluency and originality. Across the sample figural elaboration was significantly related to figural fluency and originality in both environments: HOME $r = .28^*$, $.46^{**}$; WORK $r = .27^*$, $.36^{**}$ ($*p < .05$, $**p < .005$) (Table 5). However, the relationships were significant only for low CPS scorers, (Table 7). For High CPS subjects elaboration was not significantly related in either direction to fluency or originality apart from a correlation of .65 ($p < .05$) for normal instructions in the home environment. It appears that among the High CPS subjects, who demonstrated greater variability in their performance and vulnerability to internal and external conditions, elaboration and fluency were antithetic for some individuals whereas with Low CPS they tended to covary. This was not due to performance level as the two groups did not differ significantly on absolute scores. Torrance's proposition receives some support but modified by individual differences in creative personality as measured by the CPS.

2. The expression or awareness of emotions is

considered to be a key creative strength by Torrance (1979) and the Feeling measure, based on emotions expressed in the figural product, is considered an index for this quality. This measure was nonsignificantly or negatively related to the other measures of creativity used in this study (Table 20).

3. Torrance (1979) has found Unusual visual perspective to be one of the most effective single predictors of adult creative achievement. In the present study support for this was offered from several directions: a) significant correlations occurred with the HQ and a number of BDS subscales and were particularly strong with High CPS scorers. The CPS scale, which has been validated against criteria of creative achievement was not significantly related however. b) subjects who classified themselves as creative/productive achieved the highest scores on Unusual visual perspective relative to the other self-classification groups. c) academics achieved significantly higher scores on this measure than the technical/secretarial group ($p = .02$) and were generally superior on other creativity measures.

4. Although not explicitly proposed by Torrance (1979) it might be hypothesized that the measures of Richness and Colorfulness of Imagery in figural performance would relate to individual differences in visual imagery ability. These TTCT measures were not significantly related to the imagery ability scales of vividness and control, nor was there an interactive effect of vividness and control in predicting the ratings. It appears that the scoring system for imagery demonstrated in the figural product is not associated with visual imagery ability or to utilization of

imagery in TTCT performance.

5. The ability to fantacize is considered by Torrance (1979) to be a hallmark of the creative person and is measured in the TTCT by the criterion score of Fantasy expressed in figural products. This proposition receives some support with significant relationships occurring with BDS subscales, particularly strong for High CPS scorers (Table 20) and a low but significant relationship with originality of word associations.

6. Combination of repeated figures was the only criterion measure, apart from Feeling which was unrelated to any of the creativity measures used in this study.

A RECAPITULATION

What progress has been made towards the initial goals?

1. Support for empirical literature.

Although broad consistencies with previous findings occurred, the use of a multivariate design and a sample representing a range of creative characteristics resulted in a more differentiated picture. This complexity, obscured in a bivariate and group comparison focus, does not support the conceptualization of creativity as a normally distributed, unitary trait.

Creative performance, as measured by the Torrance Test battery, was influenced by task demands, environmental characteristics and personality factors. These variables interacted in a manner which suggests that previously

reported reliability levels are misleading (Torrance, 1974; Torrance & Ball, 1980) and that cross-situational stability applies more to less creative individuals. Those more creative demonstrated widely variable performance, particularly with non-verbal tasks, and environmental influences were more salient. Although no specific dimensions in the environmental ratings were significantly related to improved performance on TTCT tasks, the home environment, where performance was generally superior, was perceived in a more positive way. Compared to their less creative counterparts, significant differences in perception of the home environment occurred with respect to greater freedom, less rigidity, greater expressiveness and spontaneity and an intellectual-cultural orientation. The task demand for novelty (instructions) enhanced inter-situational stability considerably for these subjects, resulting in reliability coefficients which were much higher than previously reported (Torrance & Ball, 1980).

Harrington's (1975) study, which demonstrated a differential effect of instructions for high and low scorers on the CPS and TTCT, was not replicated in the present investigation. However, his interpretation of the experimental results did receive indirect support. A stronger relationship did occur in the "Be Creative" instruction group between the TTCT and both the Holmes Questionnaire and the Behaviour Disposition Scale, which indicates improved construct validity for the TTCT when testing conditions are modified by more explicit instructions. Although the BDS was less consistent in predicting TTCT performance compared to the HQ, across the

sample, when situational and personality influences were partially controlled by examining specific subgroups, this resulted in superior predictive power of BDS subscales relative to any other creativity measure in this investigation. The inference of a motivational effect from instructions is not directly supported by these results but is suggested by the results for self-concept categories. For subjects classifying themselves as creative/productive, "Be Creative" instructions led to improved performance on verbal divergent tasks and several nonverbal criterion measures; for the self-concept group of creative/unproductive, figural performance was enhanced, but for those evaluating themselves as uncreative/productive performance on non-verbal tasks was generally suppressed. In addition to having an influence on absolute scores in TTCT tasks, instructional set appeared to increase utilization of visual imagery ability in performance.

It was evident from the results, that the TTCT battery measures a complex of subabilities possessing a degree of independence. Although the addition of criterion measures in the revised version seems to have improved validity by sampling a wider range of cognitive processes, further evaluation of these measures is required. The utility of several, particularly Colourfulness of Imagery, Feeling and Combination of Incomplete Figures, remains questionable.

The construct validity of "opposite responding tendency" (Janusian thinking) as a cognitive ability associated with creativity, was supported in the current

findings. This measure was significantly related to other cognitive abilities but not to personality/attitudinal variables. The strong relationship with visual imagery dimensions suggests imagery as a mediator and is theoretically relevant to the definition of "simultaneous conceptualization". The cognitive-behavioural variable of information-seeking behaviour was not associated with other correlates of creativity under any conditions. The failure to replicate Kasperson's (1978) findings may be due to a field- or task-specificity of this variable in creative behaviour. However, the validity of this measure in the investigation of creativity in non-selective samples has not been supported.

Cognitive abilities or processes appear to vary in their contribution to creative performance, individually and interactionally. For example, vividness of imagery was found to be strongly associated with nonverbal divergent thinking and Janusian thinking but of little significance to verbal divergent performance, in itself. However, the combination of vivid and controlled visual imagery was advantageous in verbal tasks. On the other hand, visual imagery appeared to interfere with performance on some tasks when imagery was vivid and autonomous, but this relationship reversed in direction with the demand for novelty.

2. Implications for future research.

It is evident that the perspectives taken in much of the previous literature have tended to obscure the complexity of creative behaviour. Rather than focus on the person, or the process, or facilitating environments, or the

product, a more useful conceptual scheme for descriptive, assessment and predictive purposes may be:

1) identification and measurement of cognitive abilities which singly or interactively, contribute to particular types of creative problem-solving.

2) identifying and measuring factors affecting utilization of potential ability in creative performance i.e. the sufficient conditions of creative behaviour for individuals.

In pursuit of the first aim, the nature, dimensions and subprocesses underlying creative abilities need to be more clearly defined. For example, visual imagery has been demonstrated to contribute to creative problem-solving but interpretation of the relationship is limited by the lack of an imagery typology defined by the dimensional measures. This is especially true of the control measure. Inferring autonomous image experiencing alone from low GCIQ scores is absurdly simplistic, probably fallacious, and has little utility in attempting to explain a complex functional relationship.

In addition, optimizing conditions and instructions for measuring creative abilities require increased attention. In this investigation the instructions used with the TTCT tasks influenced verbal and nonverbal performance differentially and the effect was also modified by personality characteristics. Rather than an either/or interpretation, instructions may have both a disambiguation function, as Katz & Poag (1979) suggested, which is task specific, as well as an attitudinal function which is

related to personality characteristics. The demand for novelty may be motivating to some individuals in some situations, and suppress performance of others in particular situations, due to a combination of factors such as self-concept, talent, expectations and perception of environmental features such as supporting innovation, spontaneity, expressiveness.

Identification and measurement of creative abilities, the necessary condition, is only the first step. The determinants for utilization of abilities in an adaptive manner, the sufficient condition for creative behaviour, has been an area virtually ignored in the empirical literature. In this investigation, inconsistency in performance level and utilization of abilities was more marked in subjects who were the most capable. Factors which appeared to contribute to the variability included personality characteristics and self-concept, creative orientation, environmental perception and task characteristics. The variables selected for examination in the present study can only be considered a sampling, and insufficient to formulate an ad hoc theory of motivation. In fact, at this stage the use of the term "motivation" is premature with its implication of voluntary control. Are all cognitive processes manipulatable? This question is raised, for example, by the finding that Janusian conceptualization is strongly associated with autonomous imagery.

Another direction suggested by the present results which appears fruitful for further investigation of utilization of abilities, concerns the environmental

conditions conducive to creativity. Previous writers' disenchantment with this area is understandable when multifarious objective features are the unit of analysis. However, perception of the environment in relationship to the individual's utilization of abilities appears to be a significant influence on variability in creative behaviour from the present results and is also easily quantified for empirical study.

CHAPTER IV

COGNITIVE STYLE AND CREATIVITY : LITERATURE REVIEW

1. INTUITIVE THINKING

The psychological concept of intuition had its inception in the epistemological framework of philosophy. The two general directions which have evolved in the psychological literature are based on similar assumptions to the alternate philosophical positions. On one hand, a rather mystical, magical and irrational quality in perceiving an ultimate truth has been elaborated by some theoreticians (Krippner, 1968; Khatami, 1978) while others have placed intuition in a more behavioral framework which can be subjected to empirical investigation (Westcott, 1968; Perkins, 1981; Bastick, 1982). A satisfactory definition has not been forthcoming although some researchers have offered operational definitions which are functional for specific lines of investigation. Probably the most representative of these is Westcott and Ranzoni's (1963) definition "intuition may be described as the process of reaching a conclusion on the basis of little information which is normally reached on the basis of significantly more information". A more comprehensive approach to defining the nature of intuition is taken by Bastick (1982) who has extracted the most frequently cited properties of intuition in the theoretical and empirical literature. Experiment 2 is concerned with several of these characteristics for which the relevant theory and evidence will be reviewed.

The property which has received the most attention

must certainly be the apparent lack of conscious awareness of the basis of an intuition. Inferring preconscious processing has arisen from numerous anecdotal reports by eminent creative persons on their insight experiences. Westcott (1968) suggests several situations which could account for the noted obscurity of cognitive processes : certain elements are unconscious i.e. not reportable or the elements may be conscious but associative links are unconscious or elements may be embedded in complex contexts or elements may be perceived in a deprived manner e.g. subliminal, incidental, peripheral. This model centers on the phenomenon of preconscious information intake which has received considerable support from the empirical work on subliminal perception, hypnotic recall and incidental learning (Dixon, 1981, Bowers & Bowers, 1972; Martindale, 1977). Hypothesizing some degree of preconscious processing is polemical and the evidence tangential. Dixon (1981) concludes from reviewing the existing work on subliminal perception that stimuli which never themselves achieve conscious awareness can be processed, activate memory traces, initiate automatic responses, and influence verbal behavior and ongoing perception. In fact he suggests automatic processing may be more efficient than conscious, as in the case of a driver making an automatic response to avoid collision with another car. The Poetzl phenomenon (Dixon, 1981) which occurs both for subliminally perceived stimuli and stimuli presented above the threshold of awareness but unattended, demonstrates that information can be stored in memory and transformed into symbolic representations which emerge in dreams, imagery and fantasy.

The effects of this information may be quite different from those of consciously perceived information. This is indicated by Poetzl's studies in which only the parts of pictures which were not consciously attended to subsequently emerged in dreams. Krippner (1968) outlines an experiment by Tinnin in 1963 in which hypnotic instructions for solving an algebraic question led to an intuitive experience i.e. a sudden flash of knowledge while consciously working on the problem. He concluded that information which was not consciously perceived could be utilized in cognitive activity which may run parallel to, rather than interacting with conscious thought processes. Bastick (1982) hypothesizes that an interaction of preconscious and conscious processing usually occurs in intuitive thinking.

Nisbett and Wilson (1977) cast doubt on the notion of preconscious or parallel processing. They suggest that people are often unaware of influential stimuli in their behavior and sometimes unaware or unable to report that a cognitive process has occurred. The degree of awareness of conscious cognitive processes is hypothesized to be less when causal factors are numerous, not salient, implausible or associated with previously experienced outcomes. However, this argument does not account for the findings on behavioral effects from stimuli which are below the threshold of awareness. Perkins (1981) concurs that discernible steps would be evident in what is considered to be intuitive leaps, if careful introspective investigations were used. He considers the steps to be ordinary mental processes such as recognizing and noticing but does somewhat

grudgingly admit that there may be unconscious leaps.

Gowan (1977) argues for the existence of preconscious processing from another angle. Considering insight or intuition as one aspect of the creative process he proposes that since the variability of creativity in individuals far exceeds the limits of variability characteristic of other traits and abilities, the remaining variance is accounted for by preconscious processes and insight experiencing.

Intuitive experiences are considered by many writers in the area of creativity to play a significant role in the idea generation phase. Traditionally, insights are believed to follow an incubation period. The classical view is that incubation is consonant with preconscious processing or problem-solving activity. Evidence that an incubation period is necessary for intuition is lacking and even those who support the role of incubation in creative solutions vary in their explanations of what is occurring. An incubation period is operationally defined as time away from conscious problem-solving activity. Apart from the idea of unconscious cerebration, some theories which have been put forward to account for facilitation effects, include:

1. internal rehearsal during which more common responses are discarded in favour of more original ones (Schubert, 1979).

2. learning reminiscence where the effects of massed practice has a depressing effect upon the performance and time allows this depressing effect to disappear, resulting in improved performance (Dorsel, 1979)

3. "unfreezing" of a fixated and inappropriate view or direction (MacKinnon, 1978)

4. permits retrieval of information from memory (MacKinnon, 1978)

5. allows time for the experience of a different chain of emotional sets from those associated with the problem, thus causing new associative links (Bastick, 1982),

6. allows time for involvement of right hemisphere functions such as imagery with left hemisphere analytical processes, which permit a metamorphosis (Gowan, 1978)

7. selective forgetting; the initial plan is forgotten and a new and better plan formed, which is based on a greater accumulation of information (Hayes, 1978)

The very limited empirical work on incubation has generally been negative. Olton (1979) considers this to be a result of experimental designs based on trivial problems for which subject motivation is low and time intervals short, usually less than 1 hour. Olton attempted to improve ecological validity in an experiment in which avid chess players were presented with a chess problem. However, he still failed to produce an incubation effect. Bastick (1982) extrapolates from the research on the function of hints in solution to insight problems (Dominowski & Jenrick, 1972; Maier & Burke, 1967). He argues that since the timing of a hint or a period of interpolated activity had no influence on subsequent problem solving success, it is possible to conclude that subconscious problem-solving does not occur. Again, in these experiments the time interval was short. Maier and Burke (1967) suggest possible influences on the utilization of hints such as subtlety,

level of motivation to continue, previous experience, untested ideas remaining; all of which could lead to more positive results.

Hayes (1979) cites a 1968 study by Fulgosi and Guilford which offers support for an enhancement effect within an incubatory interval. Subjects worked either continuously or were interrupted for 10 or 20 minutes. Little gain in performance occurred with the 10 minute interval but there was considerable gain with 20 minutes. The stage in the process at which a time away occurs does seem to have an influence, (Silverra, cited in Hayes, 1979). When an interruption followed a longer period of work on a problem, both short (half hour) and longer delays (4 hours) produced a significant increase in subjects' chances of solving the problem. Murray and Denny (1969) found a period of incubation helped poorer problem solvers but not better ones. Dixon (1981) reports that the influence of subliminally presented pictures on free association was more pronounced when sleep intervened, suggesting that preconscious processes or transformations occurred. It may be that the designation of the term incubation to the intervening time has produced a red herring. This has drawn attention to the temporal aspect to the detriment of a possible more productive focus on the nature of an intuition, what triggers it, brings it into awareness and intra-/inter-individual differences.

From anecdotal reports, one of the most salient features of intuition is the subjective experience of

effortlessness. Bowers (1978) compares this experiential quality to imagery evoked under hypnosis. Using a self-report measure of effortless experiencing of imagery, fantasy and original ideas (Effortless Experiencing Scale) she found a significant relationship with both creativity and hypnotizability. However, the causal relationship is unclear from the correlational design. Bowers proposes that doing a task well may result in a subjective experience of effortlessness because it is done capably. She considers that heightened subconscious processing and receptivity to its product lies behind the experience of effortlessness and this is also associated with creativity and hypnotic performance. The only related evidence is offered by Martindale's (1977) finding that alpha waves, present during relaxation, were generated by creative subjects when they were absorbed in a problem although they were more aroused and aware of the surroundings (normally reflected in fewer alpha waves) than other subjects, while resting.

Whether or not one believes intuitive thought to be a form of mental functioning potentially available to all, there is no doubt that some people show a greater propensity for it. Jung pointed to constitutional and environmental influences on the ascendancy of a particular mental function (Wescott, 1968). There is very little research on the correlates of intuitive thinking apart from Westcott's work but in conjunction with findings in related areas i.e. subliminal perception, the utilization of incidental cues, incubation and creative personalities, some clarity emerges. Table 21 presents some of these coinciding results from the

TABLE 21

Summary of Cognitive Style and Personality Correlates
from Literature

	Creative Adults	Intuitive Problem Solvers	Receptive to Subliminal Stimuli
Openness to Inner States	*	*	*
Emotional Awareness	*	*	*
Perceive complexity of environmental cues, awareness through various sensory modalities	*	*	*
Global, abstract in perceptions & interests, not concerned with details	*	*	*
Cognitive Flexibility	*	*	*
Tolerance of Ambiguity	*	*	*
Independent, Autonomous	*	*	
Confident	*	*	*
Assertive	*		*
Oriented Towards People			*
Uninhibited	*	*	
Aggressive	*		*

References: MacKinnon (1978) Westcott (1968) Eagle (1962)
Mendelsohn & Lindholm (1972) Westcott & Ranzoni (1963)

literature.

Situational influences have been studied in regard to cognitive strategies, the restricting effect of awareness, arousal and anxiety which may be generated by task demands or other situational factors. Subliminal receptivity is highest when subjects are (1) in a low state of arousal (2) attention is unselective or broadened (3) cognitions are intuitive, global, symbolic and not bound by logical constraints (Dixon, 1981). Cited by the same author Fiss found that the degree of alertness during the input stage did not influence subjects receptivity to subliminal information but differences in alertness during the response stage of generating images did differentiate integration of subliminal information in responding. Fiss suggests that the processes responsible for registration of preconscious information appear to be independent of those which govern how we become consciously aware of preconscious information.

The restricting effect of awareness, concentration and logical, analytic thought have been discussed with respect to incubation (Torrance, 1979), range of cue utilization (Easterbrook, 1959) and receptivity to subliminal stimuli. Dixon (1981) offers a theoretical formulation which encompasses all the above, stating that conscious attention confines the content of processes to the current task and consequently denies access to related information, either incoming or stored. In Sackeim, Packer and Gur (1977) an experiment by Murch is reviewed which found that subjects who used intuitive cognitive strategies

produced more subliminal effects than subjects who used an analytic and premeditated approach to problem-solving. A further study cited by the same authors found that this effect could be manipulated by experimental instructions. Subliminal effects did not occur when subjects were encouraged to think in an analytic, logical and organised manner but did when instructions were for global, intuitive and free-thinking.

Subject variables in this area of research can be divided into several broad categories : hemispheric dominance, cognitive style and personality and attitudes. Much of the recent theory relating hemispheric dominance to creativity, intuition and subliminal receptivity has been based on the assumption of lateralization of function. The right hemisphere has been considered nonverbal, synthetic, concrete, analogic, nontemporal, nonrational, spatial, intuitive and holistic (Myers, 1982), specializing in pattern recognition (Douglas, 1977) and to involve receptive modes of processing. It is obvious why these characteristics are considered to indicate lateralization of intuitive thinking to the right hemisphere as opposed to the left which is considered the home of verbal, analytic, symbolic, abstract, temporal, rational, digital, logical and linear thought (Myers, 1982). However, Allen (1983) in a comprehensive review of current theoretical formulations of hemispheric specialization points out that most models use the hemisphere as the basic unit of analysis which may obscure more complex interactions. He proposes a general model using subprocessors as the focus. Without going too

deeply into this highly controversial area, some points relevant to the present study will be mentioned.

The concept of degree of lateralization is receiving increasing attention and it seems that it may vary between functions and between individuals. For example, theorists are not as strongly in support of unilateralization of visuospatial functions as they are of verbal functions. With respect to mode of processing the attitude is generally held that the left hemisphere processes information in a serial fashion and the right in a parallel fashion. There is some evidence for this discrimination (Allen, 1983) however theorists differ in their ideas concerning the extent of co-operative interaction and whether all information is processed concurrently in the two modes or only at certain stages e.g. in more complex processing. On the other hand, Sergent (1982) believes that lateralization of processing style e.g. analytic vs. holistic, may be an epiphenomenon and that both hemispheres carry out these processes. She considers the factors of importance in lateralization to be the frequency or fineness of detail of the information i.e. the right hemisphere is better at processing information which is unclear, incomplete, novel or when the time duration is brief. This conceptualization would still support the commonly accepted lateralization of intuitive thinking to the right hemisphere but from a different definitional perspective of intuition.

Subjects' strategy in terms of characteristic and/or voluntary mechanisms and processes used, is a particularly

important issue for interpretation of individual differences in intuitive problem-solving. It has been hypothesized that adults store information multi-dimensionally, different aspects of information being stored at different sites (Gazzaniga & Le Doux, in Allen, 1983). How much voluntary control is there in distribution of information to one hemisphere or the other? Allen (1983) suggests that allocation of encoding and processing may be more directly related to preference and expectations than task demand or innate hemispheric specialization of function. This raises the intriguing possibility of processing approaches or strategies which would take advantage of each hemisphere's capabilities for enhancing problem solving and creativity. Myers (1982) comments that we receive considerable training and practise of left hemisphere abilities in western educational systems and need to learn how to suppress this activity to allow for right hemisphere involvement. Although this statement is oversimplistic the basic tenets have significance.

2. MEASUREMENT OF INDIVIDUAL DIFFERENCES IN HEMISPHERIC LATERALIZATION

The use of conjugate lateral eye movements (CLEM) as one index for monitoring hemispheric contribution in behavior is based on the assumption that direction of eye movement indicates activation of the contralateral hemisphere. As yet, the relationship between eye movement and specific cognitive processes is unclear and some writers question the validity of the hemispheric asymmetry model of

conjugate lateral eye movements, proposing determinants of ocular behavior other than a direct relationship with cognitive processes, e.g., interpersonal, emotional arousal and cognitive style factors (Berg & Harris, 1980; Gumm, Walker & Day, 1982; O'Gorman & Siddle, 1981; Woods & Steigman, 1978; Hiscock, 1977; Tucker, Roth, Arneson & Buckingham, 1977; Ehrlichman & Weinberger, 1978). However, recent studies using physiological indicators of hemispheric activation such as blood flow and electrophysiological differences have offered some support for the asymmetry model of CLEM, (Gur & Reivich, 1980; Shevrin, Smokler & Kooi, 1980). Less direct validation evidence has been offered by O'Gorman & Siddle's (1981) findings that CLEM direction was a more sensitive index of differences in question type than electrodermal activity and by studies which induce voluntary lateral eye movements e.g. using eye goggles, to examine the effect on cognitive processing (Gross, Franko & Lewin, 1978).

The most logical conclusion at this point, considering the often contradictory and inconclusive research findings, would seem to be that direction of eye movements is a function of asymmetrical functional organization of the brain (including cognitive processes and emotional/personality-related factors) as well as situational characteristics such as arousal due to interpersonal factors.

Individual consistency in direction of movement, observed by early investigators (Day, 1964; Bakan, 1971) has

been substantiated recently (Ehrlichman & Weinberger, 1978). These authors obtained a mean of 76% intra-subject consistency within a single session and a reliability coefficient of .77 between two experimental conditions. In one study, individual consistency in CLEM was found to develop as early as age three and a half years and to be similarly proportionate as in adults (Reynolds & Kaufman, 1980). Consistency has generally been observed to be greater in a face-to-face assessment of the eye movements when the experimenter is visually absent (Gur & Gur, 1977; Hiscock, 1977; Ehrlichman & Weinberger, 1978). However the explanations offered for this variability in the demonstration of characteristic tendencies have not received consistent support.

The controversy over the validity of the hemispheric asymmetry model of conjugate lateral eye movements will probably remain unresolved until the methodological problems characterizing studies in this area are clearly identified and overcome, e.g. operational features of movement scoring such as length, degree, sequence; face validity of questions used. For a comprehensive discussion of these issues, see Ehrlichman & Weinberger (1978). Despite this controversy, evidence is accumulating that individual differences in cognitive style, personality and attitudinal variables are associated with characteristic patterns in eye gaze. Table 22 provides a selective summary of the research findings.

TABLE 22
Selective Summary of Research Findings for Personality and Attitudinal Differences
between Left and Right Movers

<u>Right Movers</u>	<u>Left Movers</u>
Prefer cool colours (Bakan, 1971)	Tendency to focus on internal subjective experiences and feelings (Ehrlichman & Weinberger, 1978; Otteson, 1980)
Interested in science, quantitative and language areas (Bakan, 1971; Katz & Salt, 1981; Combs, Hoblick, Czarnecki & Kamler, 1977)	More susceptible to persuasion (Sherrod, 1972)
Deal with conflict in a more active, externalizing manner (Gur & Gur, 1975)	Interested in classical and humanist areas (Bakan, 1971; Katz & Salt, 1981)
Obsessive personality style, greater dogmatism (Smokler & Shrevin, 1979; Otteson, 1980)	Less concern for external expectations (Otteson, 1980)
Demonstrate more pronounced subliminal effects in an organized condition, when instructed to be precise and consistent (Sackeim, Packer & Gur, 1977)	Score higher on measures of defense mechanisms employing internalization of conflicts, hysterical personality style and psychosomatic symptomatology (Gur & Gur, 1975; Smokler & Shevrin, 1979)
Right movement of the eyes occurs more frequently in response to positive emotions of happiness, excitement (Ahern & Schwartz, 1979)	Demonstrate more pronounced subliminal effects when instructed to be free and impressionistic (Sackeim, Packer & Gur, 1977)
Score lower on a measure of emotional reactivity and expression (Woods, 1977)	More expressive nonverbally of disgust and fear (Graves & Natale, 1979)
	Left movement of the eyes occurs more frequently in response to emotional questions, fear, stressful situations and in subjects with low self-esteem (Tucker, Roth, Arneson, & Buckingham, 1977; Ehrlichman & Weinberger, 1978; Katz & Salt, 1981; Libby & Yaklevich, 1973)

3. INDIVIDUAL DIFFERENCES BETWEEN INTUITIVE AND NON-INTUITIVE THINKERS

With respect to cognitive style, personality and attitudinal differences between intuitive-thinkers and non-intuiters, theory has far outweighed empirical investigation. The only direct experimental focus on correlates of intuition has compared successful intuitive problem-solvers, using the incomplete information model, with unsuccessful but low information demanders and successful but high information demanders (Westcott & Ranzoni, 1963; Westcott, 1968). The personality and attitudinal correlates are presented in Table 23. Many of the theoretical formulations have been extrapolations from the research on creative personalities (Bastick, 1982) with the as yet unsupported assumption that creatively productive people are also intuitive. At face value there are many parallels (Table 21) but the verisimilitude is questionable, lacking empirical support. Emotional involvement takes a leading role in many of the theories of intuitive personalities. The tendency to become emotionally involved is considered to enhance multidimensional encoding of information (Bastick, 1982) to energize the creative field resulting in vibration of elements to create original combinations (Vargiu, 1977) to channel and motivate enquiry (Perkins, 1981) to trigger insights (Bastick, 1982), to retrieve relevant information (Weiner, 1966) and to enhance incubation (Torrance, 1979).

Openness to peripheral or subliminal information, a characteristic contained in most theories, has been found to

TABLE 23

Summary of Personality and Cognitive Style Correlates of
Successful and Unsuccessful Intuitive Problem Solvers
(from Westcott, 1968)

1. INTUITIVE AND SUCCESSFUL

- tendency to be more impulsive and flexible in problem-solving
- unconventional and comfortable in unconventionality
- deeply involved emotionally, commit themselves
- experience fluctuations in affect
- accept challenges readily and eagerly
- enjoy risk, seek out instability, tolerant of uncertainty
- concerned with abstract issues
- accept influence from others to further their own development
- assess themselves as alert, independent, foresighted confident and spontaneous

2. ATTEMPT INTUITIVE SOLUTIONS BUT UNSUCCESSFUL

- less flexible in problem-solving
- unconventional but desperate, anxious in unconventionality
- emotionally involved but affect more concentrated on self-absorption than on task orientation
- less interested in people
- assess themselves as alert, quick, headstrong and cynical

3. NON-INTUITIVE (HIGH INFORMATION DEMAND) BUT UNSUCCESSFUL

- less impulsive though more flexible than (2)
- cautious, conservative, well socialized, confident
- do not enjoy risk
- assess themselves in terms of social virtues, cautious, kind, modest, confident, resourceful, foresighted, spontaneous

increase originality in verbal associative performance (Mendelsohn & Griswold, 1966; Mendelsohn & Lindholm, 1972; Dixon, 1981) and is affected by emotional factors.

Attitudes, consciously held or so ingrained as to be preconscious, may influence emotional involvement and perceptual openness. Meichenbaum (1975, 1977) asked subjects to think out loud while problem-solving. He found that non-creative subjects produced negative statements devaluing themselves in terms of their creativeness and devaluing the tasks, and if they did produce a creative response, devaluing their own performance. When their self-talk was modified, in a manner similar to the psychotherapeutic technique of cognitive restructuring, performance changed in the direction of the more creative subjects, on divergent thinking tasks, on human movement responses to an inkblot test and in preference for complexity. Westcott (1968) also found that successful intuitive problem-solvers were more positive in their attitudes to the task. These negative attitudes could influence perception, cognitive strategies and persistence. Vargiu (1977) stresses the importance of attitudes particularly during early stages of problem-solving, for persistence and for generating the mental tension which leads to intuitive associations.

In a similar vein to Meichenbaum's experimental modification of automatic self-statements, Bowers and Bowers (1975) gave instructions to subjects to perceive in unconventional ways, notice aspects of problems previously overlooked, ignore the possibility of criticism and feel

confident about their ability to do well on creative tests. A group receiving instructions under hypnosis improved performance significantly on a divergent thinking task over a relaxation control group.

CHAPTER V

EXPERIMENT 2: INFLUENCE OF PERSONALITY, ATTITUDES AND
HEMISPHERIC PREFERENCE ON INTUITIVE PROBLEM-SOLVING

RATIONALE

Intuitive thinking has played an important role in traditional theories of the creative process. However there has been little effort directed at empirical investigation. The present study attempted to operationalize and empirically examine the role of several commonly cited properties e.g. preconscious processing, effortless experiencing, a preceding incubatory period and lateralization to the right hemisphere. The literature on subliminal perception, utilization of incidental information in problem-solving, automatic self-statements and hemispheric specialization was drawn upon to conceptualize and design the present study.

Although a priori hypotheses are implicit in the design e.g. concerning the receptivity to and utilization of subliminal information, the experimental data was treated as a basis for post hoc analyses directed at a number of questions raised from previous literature and directly from present findings.

METHOD

Subjects

The 55 subjects who participated in this study were volunteers from an introductory level psychology course. Thirty-one males and 24 females comprised the sample. Mean age was 21 years with a range from 18 to 45 years.

Measures

1. Personality : Gough's Adjective Checklist (ACL) (Gough & Heilbrun, 1980) was scored for a selection of scales which were considered to be relevant on the basis of the literature relating personality factors to cognitive styles and an attempt to minimize redundancy of information contained in personality descriptors and correlates of the ACL scales. These were the

¹
(1) Modus operandi scales - Number checked, Favourable, Unfavourable, Communalilty.

(2) Need scales - Achievement, Dominance, Endurance, Order, Intraception, Autonomy, Change.

(3) Topical scales - Self-control, Self-confidence, Personal adjustment, Creative personality.

(4) Welsh's Origence-Intellectance scales.

Standardized scores were used in the analyses. In addition frequencies of individual adjectives were calculated for specific subgroups, described in the results section.

¹
for summary descriptors of personality and cognitive style characteristics associated with each scale (Gough & Heilbrun, 1980) see Appendix 5.

2. CLEM : Measurement of lateral eye movements in response to six prototypic verbal and visuospatial questions was conducted in a face-to-face positioning by a trained female research assistant. Subjects were classified as Left- or Right-movers on the basis of predominant direction of initial eye gaze following presentation of the question.

3. Insight Riddles : Two pictorial riddles with verbal captions were selected from Garner's (1978) book containing a variety of problems and riddles, solution of which require mental leaps associated with intuitive insights. Selection of the riddles was made so that subject differences in experience or training would not influence ability to solve. The pictorial clues were devised by the experimenter to provide the "missing link". Although concordance on the face validity of the clues was obtained from several staff members in the psychology department, their validity cannot be considered as substantive.

This type of problem differs from those used in previous research on intuition (e.g. Westcott, 1968) which have typically been solvable by analytical processes with the requisite information and also tended to be susceptible to differences in practical experience.

4. Self-report Questionnaire : Subjects indicated (i) the length of the incubation period before a solution was reached, (ii) the nature of the solution i.e. following a period of conscious problem-solving activity or no awareness of preceding thought about the problem, (iii) the degree of effort experienced in reaching a solution, rated on a scale from 0 (no effort) to 5 (considerable effort and concentration). A rating of effort specific to the task was

hypothesized to have more predictive validity than measuring a generalized characteristic of effortless experiencing as Bowers (1978) did.

Procedure

Subjects were randomly assigned to one of several experimental conditions.

- (i) Clue or No Clue, presented subliminally.
- (ii) Order of positive or negative statements received. These were based on Meichenbaum's (1977) findings and related to self and task attributions. The statements were shortened to fewer than five words and presented subliminally.
- (iii) Order of riddles.

The rationale underlying subliminal presentation of the attitude statements was that they would have a greater influence in modifying automatic attributions than if consciously perceived. Similarly, presentation of clues at a preconscious level was hypothesized to discriminate individual differences in openness to subliminal or peripheral information. This is outlined in the literature as an important characteristic of intuitive persons..

Each subject was seen twice with an interval of approximately one week for a trial with each of the two problems. Individual threshold was established for subliminal presentation of clues and attribution statements on slides. Illumination adjustment on the projector was used for this purpose, adjusted to 1/3 below threshold in presentation to ensure a subliminal effect (Dixon, 1981). A

50 millisecond time interval spaced the slides to guard against forward and backward masking effects.

Subjects were given a copy of the riddle to work on for 2.5 minutes then seated in a recliner chair and run through a brief relaxation exercise, in an attempt to increase receptivity to subliminal stimuli. Encouragement was given to remain relaxed and calm and to attend to the screen. Subjects who were unable to solve the riddle during the initial work period took it away for 24 hours to allow time for possible incubation. The choice to continue working on the problem during this time was left to individual inclination and motivation.

Statistical analyses included chi-square statistical tests, analysis of variance, stepwise discriminant analysis and stepwise multiple regression. The dependent variables of performance were -

1. solution classification-occurrence after conscious problem-solving activity or no awareness of preceding thought processes related to the problem
2. effort classification and rating
3. length of incubation before solution.

RESULTS

There was no effect on the dependent variables for order of positive or negative subliminal instructions, for order of riddles, for age of subjects or for subliminal clues.

1. Sex

The dependent variables did not significantly differ

between males and females. However in both trials a greater percentage of males solved the riddle after the initial work period (24% of the males compared to 15% of the females) and a slightly larger proportion of females solved the riddle after a period of incubation (35% females compared to 24% males). There was a tendency then for males to be superior in reaching quick solutions with concentrated attention to problem solving. However similar proportions of male and female subjects were unable to reach a solution at all.

2. Intra-Subject Performance

Generally, those subjects who were unable to solve the first riddle were also unable to find a solution for the second. However, there appears to be a practice effect for this type of problem. In Trial 1 only 27.3% were able to reach a solution during the work period while 50% of the sample did for Trial 2, including a small proportion of subjects who achieved no solution at first attempt. It appears that there is some consistency in ability to solve this type of problem or engage in the cognitive approach required.

3. Effect of Subliminal Instructions on Performance

There were no significant differences on any of the dependent variables between subjects who received positive or negative statements. However, it appears that the positive instructions did lead to some degree of enhancement for intuitive or effortless experiencing of a solution after incubation. All subjects who rated the effort involved as less than 3 (scale 0-5) had received positive instructions, and 14 of these gave a 0 rating. When these subjects received negative statements pertaining to their

creativeness and derogating the task on Trial 2, 5 gave the highest effort rating. However, 9 of the 14 effortless experiencers still gave a rating of 0 even with negative instructions. A small core appear to be consistently intuitive while others may intuit on occasion but are susceptible to situation and attitudinal influences. The majority of subjects who rated their effort as high tended to do so in both trials, regardless of experimental manipulations.

The length of the incubation period before a solution was reached was not influenced by the instructions received.

4. Effect of Incubation Period

Of the subjects who reached a solution after a period of incubation 61.5% classified the nature of the solution as occurring when they were unaware of thinking about the riddle. The classifications in terms of awareness of problem-solving prior to solution coincide with the degree of effort subjectively experienced. There is a significant difference ($p = .000$) in the effort ratings between the two classifications of solutions reached after incubation.

Stepwise multiple regression with the personality scales of the ACL did not yield a single variable or combination of variables significantly related to the length of the incubation period before reaching a solution. The highest partial correlation was with the Creative Person Scale (CPS), $r = .25$, $p = .18$. High scorers, identified as more creative according to the fairly extensive empirical validation of this scale (Gough & Heilbrun, 1980) tended to have longer incubation periods. The lengthiest time was 9.5 hours, however if a solution was going to be obtained after

incubation it was usually within 2 or 3 hours. When this is taken into consideration together with the results of the discriminant analyses following, it is evident that this relationship is somewhat spurious. It appears to reflect the dimension on which solutions following any period of incubation are separated from immediate solutions.

The Creative Person Scale did relate significantly to the Effort ratings ($r = -.30$, $p = .02$) with high scorers experiencing effortless solutions.

5. Hemispheric Dominance (CLEM)

The difference between predominantly right movers and left movers was not statistically significant for any of the dependent variables nor were there any interactive effects, however, there was a slight tendency for left movers to experience an intuitive solution and also to benefit from experience in this type of problem. A number of left movers who were unsuccessful in Trial 1, were able to solve the second riddle (Table 24).

6. Identification of Problem-Solving Types by Personality Characteristics (ACL)

Trial 1 - Two stepwise discriminant analyses were performed with the results for Trial 1. The first analysis yielded two discriminant functions of similar discriminative importance (canonical correlations .33, .29 NS) which separated those who reached no solution (0), those who solved the riddle after the initial work period (1) and those who arrived at a solution after a period of incubation (2). Considerable overlap occurred between these categories. Only 38.6% of the sample were correctly classified by the functions derived. Function 1 separated

Table 24
Performance on Both Trials for CLEM Categories

	<u>Right Movers</u>	<u>Left Movers</u>
<u>Trial 1</u>		
No Solution	50%	53.3%
Solution : After Work Period	23.3%	13.3%
After Incubation		
+ conscious problem-	26.7%	20%
solvers		
After Incubation	0	13.4%
<u>Trial 2</u>		
No Solution	53.6%	37.5%
Solution : After Work Period	42.9%	62.5%
After Incubation		
+ conscious	3.5%	0
problem-solving		

(1) and (2) most widely. The discriminating variables (ACL scales) of importance were the Creative Person Scale (CPS), Communality (COM) and Achievement (ACH). Subjects who were successful after incubation were high on CPS, COM and low on ACH. A summary descriptive profile for each category of problem-solver, synthesizing the results from all discriminant analyses, appears in Table 25.

TABLE 25
CHARACTERISTICS (ACL) ASSOCIATED WITH SUBGROUPS OF PROBLEM-SOLVERS

Groups	ACL Scales	Direction of Relationship	Characteristics (from ACL Manual)
No Solution	Achievement	+	Hard working, goal directed, high standards in socially desirable goals, impatient, elements of self-aggrandizement and coercion in strivings, sober, diligent, lack spontaneity, overcontrolled, aloof, dutiful - - (those who never solved) characterized as less controlled, changeable, easily influenced by illogical concerns, unpredictable, unable to delay gratification, unambitious
	Self Control	+	
	A4	-	
Solution after Incubation	Creative Person Scale	+	- Venturesome, aesthetically reactive, clever, quick to respond, wide interests, creative, - reliable, considerate, free of pretence, comfortable interpersonally - does not strive to be outstanding in pursuits of socially recognized significance - Cognitively complex, internally differentiated, logical, foresighted, values cognitive matters.
	Communality	+	
	Achievement	-	
Effortless Solution	Order	-	Uninhibited, expressive but able to persevere towards distant goals, initiates humor, engages in fantasy and day dreams, somewhat impulsive, enjoys sensuous experiencing. - Conscientious, persistent - Independent, autonomous, assertive, tend to be indifferent to feelings of others.
	Endurance	+	
	Autonomy	+	
Solution after conscious problem-solving	Order	+	- Objective, rational, controlled, intolerant of change/variety, self-disciplined - Conventional, avoids risk, hardwork, goal-directed, conservative.
	Autonomy	-	

Function 2 separated (0) and (2). The dimension is dominated by the ACH scale. Those who were unable to solve the riddles on the first occasion were identified by high ACH scores.

Separating the sample in terms of the nature of the solution i.e. effortless, no prior awareness of thought processes or occurring after conscious problem-solving activity (either during initial work period or following incubation) the functions derived were more successful in discriminating the groups on personality characteristics (canonical correlation .6, $p = .08$). 78.3% were correctly classified. The most important variables defining the primary dimension were Order (ORD) Endurance (END) and Autonomy (AUT), (see Table 25). In this analysis a second function added a small degree of discrimination, identifying those who were unable to solve with high scores on self-control (SCNTRL).

Trial 2 - As mentioned previously, a practice effect for solving this type of problem seems to have occurred for a subgroup of subjects, resulting in the majority of successful solvers in Trial 2 reaching a solution after the initial work period and a proportion of unsuccessful solvers in Trial 1 reaching a solution on the second trial. Only two subjects utilized an incubatory time. Two functions were obtained from the discriminant analysis. The first clearly identified the two subjects who solved post-incubation (canonical correlation .6, $p = .005$) and separated them from other successful solvers primarily by intraception (INT) scale scores. This appears theoretically meaningful but with the extremely small N should be regarded

warily from a statistical perspective. The unsuccessful solvers in Trial 2 were clearly discriminated by a second function (canonical correlation .41, $p = .12$) which was characterized by the A4 scale - Low Origence - High Intellectence, negatively associated with these subjects. The two functions correctly classified 68% of the sample.

DISCUSSION

At face value the lack of effect for the clue seems to disconfirm the generally held opinion (Table 21) that intuiters are more open and receptive than nonintuiters to environmental information which may be unattended/peripheral/subliminal, and more open to the preconscious processing of this information. However, this result may have been influenced by the timing of the clue on the length of problem-solving activity. Though timing of hints has been found to make little difference (Maier & Burke, 1967) these results may not be generalizable to the present study which involves the interaction of conscious and preconscious information. This seems a valid distinction in view of the literature on differential effects for consciously perceived and subliminal information (e.g. Dixon, 1981) and the importance of timing on incubation (Fulgosi & Guilford, cited in Hayes, 1979). Alternatively, the clue though possessing face validity may not in fact have carried the requisite information to "bridge" the "mental leap".

In spite of a relatively brief period of problem-solving activity in this study, incubation effects did occur for some subjects. Incubation was not a necessary

condition for intuitive associations in solving the problems nor was conscious attention necessarily detrimental. However, both of these factors did operate in the anticipated direction with respect to effortlessness of the intuitive experience. The experimental design does not allow clarification of the actual processes during incubation but does allow comment on several of the theories that have been proposed. The effect of time away cannot be solely explained by returning to a problem with a fresh perspective as the majority of subjects demonstrating incubation effects were not consciously thinking of the problem prior to solution. Incubatory effects did not discriminate right and left hemispheric preference, as measured by CLEM, which casts doubt on the theory that incubatory processes are specific to right hemispheric processing. Interpolated sleep did not result in any solutions though it could be argued that these subjects who were able to solve the insight problems did so after relatively short incubation intervals. Consequently, the presumed subconscious processing during an altered state of consciousness did not have an opportunity to occur. More complex problems might allow examination of these processes.

The notion of preconscious processing during incubation does receive some support from the predominance of effortless intuitive solutions with no prior awareness. The lack of relationship between length of incubation and effort involved suggests this was not simply parallel problem-solving activity at a preconscious level. It seems probable that incubation time serves a variety of purposes in problem-solving. In some cases returning to the problem

after incubation resulted in a solution. In others, preconscious processes are more clearly implicated at least in retrieval of the solution.

The Creative Person Scale was associated with successful incubators, both conscious and intuitive solutions. This scale has been well validated with samples of creative and productive people from varying fields of work. Individual differences associated with incubatory effects reflect more than just ability to intuit. Possible emotional involvement and persistence, commonly associated with the creative personality leads to an internal state of resistance to premature closure, allowing preconscious processes to contribute to problem solving activity. The personality characteristics associated with the problem-solvers who receive no benefit from time away create a picture of rigidity and lack of persistence in tasks which are not easily accomplished or which do not lead to socially recognized goals. Premature closure would negate incubation effects either by preventing the processes or blocking receptivity to the product.

There was considerable stability in success and subjective nature of intuitive problem-solving among subgroups in the sample. This consistency was especially noticeable with those who solved the riddle after the initial work period. The personality profile obtained for these subjects is very similar to Westcott and Ranzoni's (1963) non-intuitive but successful problem solvers - controlled, cautious, less tolerant of ambiguity, conservative, objective. A similarity is also notable with

the subgroup of consistent intuiters who experienced effortless solutions irrespective of experimental manipulations. These subjects were characterized as impulsive, unconventional, independent and spontaneous as were Westcott et al's (1963) successful intuitors and were also persistent, open to internal and external experiences through various sensory modes, assertive and humorous, characteristics which have been theoretically associated with the intuitive personality. Though hemispheric preference did not clearly differentiate subgroups as anticipated, there was a slight tendency for left movers (CLEM) to be more adept with this type of problem and to have effortless intuitions. As Allen (1983) suggests, this may be too gross a measure to pick up complex differences in cognitive styles. Alternatively, intuitive thinking may not be solely a right hemisphere process i.e. may involve to varying degrees left hemisphere processes in an integrative fashion. However it appears that it is facilitated by right hemisphere activation similarly to spatial visualization as Gur & Reivich (1980) found.

Westcott (1968) found relatively normal distribution of types in his samples. The present results suggest the differences may not be as enduring for everyone. A number of subjects, characterized predominantly by a high need for achievement, benefited from experience. The practice effect may be explainable by subjects' vulnerability to inhibitory anxiety in the novel situation or to initial use of a preferred style of processing which is inappropriate.

Intra-subject variability in effortless experiencing

appears to be affected by emotional and attitudinal factors. The subliminal attributions demonstrated an effect only with the group of inconsistent intuitors. Ability to solve the problem was not affected but the attributions did have a strong influence on the degree of subjective effort, in the expected direction. These results suggest that effortless experiencing is sensitive to attitudinal set and is not causally related to actual skill in performance.

In summary, the findings from the study provide additional evidence for the phenomenon of intuition and extend previous empirically derived properties to include the subjective experience of effortlessness. The ability to intuit and the subjective quality of an intuition are not necessarily co-existent. Although personality differences identify some consistency in subtypes, they are not sufficient to explain variability. Situational, emotional and attitudinal factors appear to affect the quality of an intuitive experience.

This study has taken a broad perspective in the attempt to synthesize some of the areas relating to intuition. Issues raised which require further empirical investigation include:

1. the nature of preconscious processing, interaction of preconscious and consciously perceived information, triggers to conscious awareness of information.
2. the relationship of effortless intuitions and task demands i.e. is intuition limited to certain types of cognitive processes?
3. factors other than personality differences which lead to intuitive experiences.

CHAPTER VI

EXPERIMENT 3: PREDICTING AND ENHANCING PERFORMANCE IN
NON-EXPERIMENTAL TASKS

RATIONALE

The purpose of the present study was to replicate and extend some of the findings from Experiment 1 and examine a number of implications. The basic aims are outlined below:

1. The predictive utility of Taylor's Behaviour Disposition Scale for TTCT performance was considerably enhanced when a separate composite of BDS subscales was used for High and Low CPS scorers. The present study applied the revised scoring system to examine the predictive validity of the BDS, in an independent sample, for a range of non-experimental performance tasks. As the cognitive abilities measured by the TTCT can only be a circumscribed sample of those contributing to creative production, validation evidence for a creativity scale requires prediction of behaviour involving additional and more complex cognitive processes in the context of meaningful or "real-life" tasks. In the present study this was examined using academic performance level on several mid-year assessment requirements, for mechanical engineering students.

2. From Experiment 1, it was evident that individuals differ not only in visual imagery ability but also in the consistency which imagery is used as a mediator in performance. The results also suggested that the predictive validity of imagery ability measures (e.g. vividness and control) was modified by the nature of the task (verbal/nonverbal), by motivating instructions and by

environmental influences. The question was raised whether the task relevance or congruence of imagery would influence these relationships.

In Experiment 3, the predictive utility of imagery ability measures, objective measures of spatial visualization, and measures of characteristic cognitive style were compared for a range of performance tasks involving verbal and nonverbal processes.

Imagery ability and cognitive style are generally considered relatively stable characteristics. The results of Experiment 1 suggested that utilization of imagery can enhance creativity in some contexts which leads to the consideration of the possibility of training in awareness and utilization of imagery. Addressing this question, an imagery training program was developed and administered with the engineering students. The effects were compared to a verbal creativity program in order to separate specific and indirect influences on different performance tasks and the interrelationship of imagery ability with imagery utilization. Ainsworth-Land's (1982) developmental model integrating stages of creativity and imagery utilization implies that movement through the levels are parallel which has direct relevance to training focus, and differential effects.

METHOD

Subjects

Sixty students from the first year mechanical engineering program at Canterbury University comprised the

sample. Mean age was 19.4 years, minimum 18 and maximum 22 years. There was one female only, in the sample. Participation in the study was voluntary but was encouraged by the engineering department staff which led to the majority of the class taking part.

Subjects were randomly assigned to a visual imagery training group or a verbal creativity training group. Due to logistical circumstances such as course modifications and venue confusions, resultant group size differed with 27 subjects in the imagery program and 33 in creativity training. Reassignment after one session had been attended would have been a confounding influence on training effects. The verbally based creativity training group was designed to act as a control, rather than a no treatment control group. This was for ethical reasons i.e. possible beneficial effects on academic performance from imagery training, and for comparative examination of direct and indirect effects of the different processing modes in training.

Training programs

Each program was composed of 8 sessions. Attendance records were kept for assessing the contribution of this factor to experimental results and also as an additional encouragement for continued participation. Format and content outlines of the programs are contained in Appendices 7 & 8. Session duration was one hour, scheduled once weekly during regular lecture hours. The experimenter instructed the imagery training group and an engineering lecturer was trained to instruct in the creativity program. The latter program was a condensed version of that outlined by Parnes

(1967) in the "Creative Behaviour Workbook" (refer also Parnes, 1976) and is largely based on divergent thinking principles. Imagery training, on the other hand, has received virtually no direct attention in the literature. Consequently, the program was devised from theoretical and empirical writings in the areas of hypnosis/psychotherapy and visual imagery, creativity enhancement and learning facilitation with visual imagery (e.g. Fromm & Shor, 1972; Shorr, Sobel, Robin & Connella, 1980; Ruben & Rehyer, 1976; Khatena, 1978; Torrance, 1979; Ainsworth-Land, 1982; Richardson, 1969; Paivio, 1971; Sheehan, 1972). The primary goals of training were to increase awareness of an receptivity to visual imagery and practise in utilizing visual imagery.

Procedure

Prior to training, a number of measurement instruments were administered. These comprised visual imagery and spatial ability measures, and personality and cognitive style inventories. Administration and scoring criteria of the individual instruments are detailed in the "Measures" section. Approximately 3 weeks following the training period the subjective imagery scales (Vividness of Visual Imagery Questionnaire, Gordon's Control of Imagery Questionnaire) and the objective measure of perceptual control (Necker Fluctuations) were readministered. Conjugate lateral eye movement (CLEM) biases were also assessed at this time. The three dependent variables of academic performance were integral assignments and examinations for mid-year grading. These were completed within a two month period following training. They are

described together with the other measures.

A wide range of statistical analyses of the data were carried out, including descriptive statistics, analysis of variance, bivariate and multivariate correlational analyses, within the general framework of a comparative treatment experimental design. Description of particular analyses will accompany presentation of the results. Broadly, the following questions were examined:

1. the comparative effect (direct and indirect) of training programs differing in cognitive mode and processes, on imagery ability, utilization of imagery and academic performance (engineering design vs. verbal-conceptual).

2. the influence of individual differences in personality, cognitive style and hemispheric laterality.

3. validation of a revised creativity scale, Taylor's Behaviour Disposition Scale.

N.B. Some subjects did not complete all pre and post measures although followup was pursued with vigor. Listwise deletion was used in the statistical analyses to protect against spurious results from missing data on the relevant variables.

Measures

Personality and cognitive style

1. Behaviour Disposition Scale (BDS): Taylor's (1976) BDS was revised by the experimenter, based on the results from Experiment 1. In scoring, subjects were identified as high or low scorers on the Creative Person Scale (CPS) of the Adjective Checklist, then the BDS subscales which had been found to be most predictive from

each group (Experiment 1) were scored. CPS groups were established by a cutoff score of the distribution mean ($M = 47$).

High CPS: BDS subscales were Person, Emergentive, Expressive, Technical

Low CPS: Inventive, Emergentive, Expressive, Technical (BDS Total range: 0 - 60)

2. Adjective Checklist (ACL) (Gough & Heilbrun, 1980): Standardized scores were calculated for the subscales described in Experiment 2. The frequencies of individual adjectives scored by subjects in each CLEM classification group were calculated in addition to the standardized scale scores.

3. Personal Reaction Inventory (PRI): (Crowne & Marlowe, 1964). This is a measure of social desirability or the tendency to respond to items in a socially desirable manner (range: 0 - 33).

4. Verbalizer-Visualizer Questionnaire (VVQ): (Richardson, 1977b). This scale was developed to measure habitual cognitive styles. The higher the score the greater the tendency to use a visualizing style. In addition to raw scores, subjects were classified as a Verbalizer, a Visualizer or Mixed. Cutting scores for classification were based on the upper 15% of the distribution (Visualizer), the lower 15% (Verbalizer) and the intermediate 70% (Mixed) as Richardson (1977b) suggested for research purposes.

5. Conjugate Lateral Eye-movements (CLEM). Subjects were interviewed in a face-to-face situation by a male research assistant who was seated approximately 1.5 metres from the subject. It is considered that less than 1.2 metres distance falls into "personal space" (Erhlichman &

each question were recorded. Classification was based on the total number across all questions. The criterion of 70% was used for classification as unidirectional right- or left-mover. If less than 70% of movements were in either direction, classification was bidirectional mover. Classification was also made on the basis of initial eye gaze and compared to the modified procedure. In practise there was little difference in the resultant categorization and the modified version was used in analyses.

Imagery and spatial ability measures

1. Vividness of Visual Imagery Questionnaire (VVIQ): Marks (1973). This scale is scored for Eyes Open, Eyes Closed, and Total vividness. A high score is associated with less vivid visual imagery (range: 0 - 160). This results in a negatively signed coefficient in correlational analyses if vividness of imagery is associated in a positive direction with another variable. To aid intuitive understanding of tabled results, correlations which are interpreted as positive in direction are reported with a positive sign.

2. Gordon's Control of Imagery Scale (GCIS): Richardson's (1969) modified scoring system was used: Yes (2); Unsure (1); No (0) (range: 0 - 24). The subfactors Movement, Misfortune, Colour and Stationary (White & Ashton, 1977) were also scored.

3. Cutting a Cube: (Richardson, 1977a). This is a spatial manipulation task. Subjects were asked to "Imagine a cube 3" x 3" x 3" and painted red all over. Imagine that it has been cut into 27 smaller cubes each 1" x 1" x 1" by making two equidistant horizontal cuts and two equidistant

vertical cuts from the front face and the side face.. How many cubes have three faces painted red? How many cubes have two faces painted red? How many cubes have one face painted red? How many cubes have no faces painted red? (range: 0 - 4).

4. Necker Cube Fluctuations: A Necker Cube illustration was presented to each subject. Instructions were to fixate the cube for 60 seconds and while doing so to make a mark with a pencil each time a perspective reversal occurred, under two conditions: first with the subject "willing" as fast a rate of reversal as possible and secondly "willing" as slow a rate as possible. The difference score between the two conditions was used as a measure of perceptual control, the higher the score the higher control. This is considered to be an objective measure of visual imagery control by Richardson (1977a).

Imagery utilization

Two ratings of imagery utilization in completing an engineering design project, were obtained.

1. Self-rating: Subjects completed a questionnaire at the time of preparing the design assignment in which they were asked to rate the vividness of visual imagery experienced at any stage of preparation, which influenced their work (range: 0 - 15; rating scale 1 - 5, as in VVIQ, at idea generation stage, development stage, communication stage). Subjects were also instructed to identify visual imagery as voluntarily controlled (1) or autonomous (2) or both (3) at each stage.

2. Observer rating: Two engineering dept. staff independently rated the extent to which visual imagery

utilization was apparent in the finished product. Appendix 9 outlines the specific criteria (range: 0 - 14).

Creativity rating

1. Observer rating of the engineering design project. The two staff members also rated each project for creativity demonstrated (range: 0 - 8). The criteria (Appendix 9) for observer ratings were devised in liaison between the experimenter and engineering departmental staff. As the criteria are idiosyncratic to this particular study, although guided by the literature on creative products, generalization from the results must be cautious. Interrater reliability was $r = .74$ ($p = .000$) for both visual imagery utilization and creativity ratings. In subsequent analyses only Rater A scores were used as Rater B protocols were less complete.

Dependent variables of performance

1. Engineering 205. Mechanics of Fluids and Engineering Thermodynamics. This is a theoretical course consisting mainly of mathematical analysis of engineering systems.
2. Engineering 206. Engineering materials and manufacturing technology. This course is primarily descriptive and technological, how to make things and how they behave.
3. Engineering Design Project. This was a machines assignment of engine force analysis involving diagrammatic design relevant to particular criteria.

RESULTS

1. RELIABILITY OF VVIQ AND GCIQ

The subscales of the VVIQ (Eyes Open, Eyes Closed) were strongly related both in pre-testing and post-testing. r 's = .92, .86; p = .000. Only the VVIQ total scores were used in further analyses.

The internal consistency of GCIQ subfactor scores, pre-training, was lower in the present sample than in Experiment 1. Significant intercorrelations occurred only between subfactors Movement and Colour (r = .32, p = .01) and Stationary with Misfortune (r = .39., p = .001). The former relationship replicates findings from Experiment 1. It is evident from the two studies with varying samples that imagery control of the scale subfactors tends to be relatively independent within individuals. Indeed, control of Movement was negatively related to total GCIQ scores (r = -.51, p = .000). The differential predictive validity of the GCIQ subscales, described in a later section, emphasizes the low internal reliability of this imagery measure.

2. INTERCORRELATIONS BETWEEN IMAGERY AND SPATIAL MEASURES

As in Experiment 1, pre-test intercorrelations between the VVIQ and GCIQ total and subscores, did not reach significance.

Perceptual control (Necker) was significantly related only to GCIQ Movement (r = .36, p = .001). This seems theoretically meaningful and offers some support for Necker

Reversals as an objective measure of imagery control but this relationship appears limited to the movement aspect of images. Generalization to other forms of imagery control would not be reliable, particularly as the Necker measure shared a greater variation with vividness of imagery ($\underline{r} = .26$, $p = .05$) than with the other GCIQ subfactors.

The spatial manipulation task (Cube Cutting) was unrelated to the imagery measures apart from a low correlation with Necker scores ($\underline{r} = .26$, $p = .05$). It became apparent when this test was being administered that visual imagery was not necessary to achieve a solution and many subjects solved the problem mathematically. Perhaps instructing subjects to use imagery in problem-solving would increase the validity of this task.

3. RELATIONSHIP BETWEEN IMAGERY AND COGNITIVE STYLE MEASURES

The sample distribution of VVQ scores was comparable to Richardson's (1977b) with a mean of 10.26. Analysis of variance yielded no significant main effects for Verbalizer-Visualizer-Mixed (VVQ) cognitive style categories. VVQ raw scores were significantly related to GCIQ Movement and Cube Cutting ($\underline{r} = .25$, $p = .04$; $\underline{r} = .27$, $p = .05$ respectively). These results suggest that a visualizer cognitive style as measured by the VVQ is associated with spatial manipulation ability but not visual imagery ability per se. Replicating Edwards & Wilkin's (1981) analysis, a multiple regression was performed with VVQ and imagery/spatial abilities measures. Multiple

correlation coefficient was nonsignificant and only 4% of the variation in VVQ scores was accounted for by imagery/spatial abilities. These findings confirm Edwards & Wilkin's (1981) doubts concerning the construct validity of the VVQ.

4. RESPONSE BIAS (SOCIAL DESIRABILITY)

Sample mean on the Personal Reaction Inventory was 13.4, comparable to Crowne & Marlowe's (1964) reported university student sample distributions. It appears from correlational analyses (Table 26) that all the imagery measures were subject to a social desirability response bias to some degree, supporting Di Vesta et al's (1971) findings. Total GCIQ was significantly negatively related to PRI however the total score obscured a strong positive relationship between Movement and PRI and a moderate one with Colour subfactor. Previous research which has found no response bias for control of imagery has used Total GCIQ scores only, which would account for nonsignificant results if the present findings are reliable.

5. PERSONALITY CORRELATES OF IMAGERY ABILITY MEASURES AND PRI

Stepwise multiple regression analyses were performed with the ACL scales as independent variables, for VVIQ, GCIQ and PRI scores, to examine personality predictors of imagery ability and the construct validity of the Personal Reaction Inventory. The PRI has been the measure of social desirability used in previous research on response bias and

TABLE 26

CORRELATIONS BETWEEN PRI (SOCIAL DESIRABILITY) AND IMAGERY ABILITY, SPATIAL ABILITY,
IMAGERY CHANGE SCORES

SUBJECT GROUP	VVIQ	TOTAL	GCIQ COLOUR	MOVEMENT	STATIONARY	MISFORTUNE	NECKER	CUBE	CHANGE VVIQ	SCORES GCIQ
ACROSS SAMPLE										
pre-training	.42	-.31	.35	.77	-	-	-	-	-	-
post-training	.27	-.42	-	.81	-	-	-	-	-	-
IMAGERY TRAINING										
pre-training	.67	-	-	-	-	-	-	-		
post-training	-	-	-	-	-	-	-	-	-.79	.41
CREATIVITY TRAINING										
pre-training	.38	-.49	.48	.82	-	-	.41	-	-	-
post-training	.33	-.53	-	.84	-	-	(.27)	-	-	-

all correlations $p < .05$ except () indicates $p < .08$

its validity has been accepted without question.

In the regression analysis for the VVIQ, the Creative Person Scale was the only variable entered in the equation ($R^2 = .26$, $p = .004$). This supports previous results from the literature and Experiment 1 which associate vivid imagery with creative persons. The GCIQ was predicted by A3 (Low origence - Low intellectence), ($R^2 = .12$, $p = .01$). The summary descriptors for this scale (see Appendix 5) portray a high scorer on the GCIQ as unpretentious, forthright, adaptable and affiliative. Partial correlations for variables not entered in the equation ordered Change and Favourable as the next most important predictors, related in a negative direction to control of imagery. High control then is associated to a lesser degree with a stability seeking, unimaginative, risk-avoiding personality style.

Variation on the PRI was significantly predicted by the combination of Intraception and Change scales ($R^2 = .32$, $p = .0001$). High scorers on these scales would be described as logical, foresighted, valuing intellectual and cognitive matters, enjoying change and variety, perceptive, spontaneous and aesthetically minded. Although not meeting the criteria for entry into the regression equation, the next highest partial correlation was with the Creative Person Scale and in simple correlational analysis, this scale was most strongly related with the PRI.

It appears then that a substantial proportion of the shared variation between the PRI and vividness of visual imagery measures, which has been documented, may be due to

shared personality correlates which cannot be said to describe a strong need for social approval. These findings do not necessarily cast aspersions on the construct validity of the PRI but do raise doubts about its ability to discriminate between individuals who unrealistically rate themselves in socially desirable ways and those who appear to realistically and accurately assess themselves in favourable terms. Consequently, the relationship between the VVIQ and PRI cannot be accepted as strong evidence against the validity of the imagery ability scale. Additional support for this contention is offered by the nonsignificant relationships between imagery ability measures and the PRI, following training, in the imagery training group alone (Table 26) which contradicts expectations if self-ratings of imagery largely reflected demand characteristics or a social desirability response bias.

6. EFFECT OF TRAINING ON IMAGERY ABILITY RATINGS

Analyses of variance demonstrated no significant differences between Imagery and Creativity training groups on pre- or post-test imagery measures. In both groups there were significant changes in VVIQ scores ($p < .05$) following training, in the direction of more vivid visual imagery (Table 27) although the magnitude of change was greater with imagery training.

There was no change in group means for GCIQ total or subscores with either training program. It is noteworthy that this sample was substantially higher on control of

TABLE 27

TRAINING GROUP MEANS FOR PRE- AND POST-IMAGERY SCALE SCORES

TRAINING GROUP	VVIQ	TOTAL	GCIQ COLOUR	MOVEMENT	STATIONARY	MISFORTUNE	NECKER
CREATIVITY							
pre-	71.1	21.0	5.0	7.0	5.4	6.4	20.1
post-	65.3	20.8	4.9	5.9	5.7	6.4	21.9
IMAGERY							
pre-	82.0	22.3	5.1	5.3	5.6	6.6	23.2
post-	63.9	23.2	5.4	5.5	5.5	6.8	28.3

N.B. a lower score on VVIQ reflects more vivid visual imagery

imagery to begin with, than previously reported distributions.

Necker scores increased, in the direction of greater perceptual control, in the Imagery training group only but the increase was just short of significance ($p = .07$).

Following training, subjects in the Imagery group demonstrated much greater interdependence among imagery and spatial ability measures relative to pre-training intercorrelations and relative to the Creativity group who did not vary from the pre-training pattern. Following imagery training, internal reliability of the GCIQ improved (Table 28). The strong relationship between control and vividness demonstrated in this group post-training ($r = .69$, $p = .001$) is particularly interesting considering the small or nonsignificant correlations previously reported in the literature.

The change in imagery ratings is not easily accounted for by a response bias influencing test-taking attitude. In fact, "change" scores (pre to post test difference) calculated for the VVIQ were significantly negatively related to PRI (Table 26) in the Imagery group. Although a significant positive relationship was obtained with GCIQ change scores, examination of data plots revealed that this relationship occurred only for a small proportion of subjects. The trend in both training groups was no change or change towards less control (Table 27 & 29). Again, this appears to contradict a demand bias.

TABLE 28

INTERCORRELATIONS BETWEEN POST-TRAINING IMAGERY AND SPATIAL ABILITY MEASURES
FOR EACH TRAINING GROUP

CREATIVITY TRAINING GROUP								
	VVIQ	GCIQ TOTAL	COLOUR	MOVEMENT	STATIONARY	MISFORTUNE	NECKER	CUBE
VVIQ							.31	
GCIQ TOTAL								
COLOUR				.32	.39			
MOVEMENT			.32					
STATIONARY			.39			.39		
MISFORTUNE					.39			
NECKER	.31							
CUBE								
IMAGERY TRAINING GROUP								
VVIQ		.69					.31	
GCIQ TOTAL	.69						-.35	
COLOUR					.48	.64		
MOVEMENT								
STATIONARY			.48			.52		
MISFORTUNE			.64		.52			
NECKER	.31	-.35						.34
CUBE							.34	

All correlations $p < .05$ except () indicates $p < .06$

TABLE 29

IMAGERY CHANGE SCORE MEANS FOR EACH TRAINING GROUP

TRAINING GROUP	VVIQ CHANGE	GCIQ CHANGE	NECKER CHANGE
IMAGERY	21.2	- 4.3	2.3
CREATIVITY	- 3.7	- 2.7	- 1.7

A change towards more vivid visual imagery was negatively related, across the sample, to change towards increased imagery (GCIQ) and perceptual (Necker) control, r 's = $-.46$, $-.30$; $p < .05$. In other words, increased vividness as a result of training, in both groups, was associated with lowered control or more autonomous imagery being experienced. This pattern was stronger in the Imagery group. In each training group pre-test VVIQ raw scores were significantly related to VVIQ change scores ($r = .77$, $p = .000$ in Imagery group; $r = .45$, $p = .01$ in Creativity), indicating less vivid images made greater changes in vividness. This relationship was more consistent with imagery training.

Cognitive style as measured by VVQ was not associated with the effects of training. Although CLEM categorization as left-, right-, or bidirectional-mover did not have a significant influence on post-test imagery or change scores (ANOVA), in the Imagery group, those subjects who increased in their vividness ratings were predominantly left movers. In fact, all the left movers in this training group ($N = 9$) demonstrated a change towards more vivid imagery. There were no right movers among those subjects whose vividness ratings increased more than 10 scale points. As suggested in previous studies (Gur & Reivich, 1980) lateralization of

imagery processes to the right hemisphere does not appear to be "hardwired" however a right hemisphere bias does appear to facilitate visual imaginal processes. Perhaps individuals who demonstrate a right hemisphere bias are more practised in this processing mode therefore are more responsive to visual imagery training.

7. EFFECT OF TRAINING ON PERFORMANCE

Prediction of performance variables from imagery measures

Multiple regression analyses were conducted separately for each training group, to examine predictive utility of pre- and post-test imagery, spatial and cognitive style (VVQ) measures.

In the Creativity training group, prediction of the three performance variables did not reach significance for any independent variables.

Pre-training measures were not of sufficient predictive power in the Imagery group to be entered in the multiple regression equation. However simple correlational analyses yielded moderate but significant ($p < .05$) relationships between 1) GCIQ Colour and the design project (negative direction) 2) VVIQ, Cube Cutting and Engineering 205 3) Cube Cutting and Engineering 206.

From the post-test measures, GCIQ Movement was significantly related to all three performance variables in simple correlations ($p < .05$) and in the multiple regression analysis ($R^2 = .29$, $p = .03$) for Engineering 206. Almost

30% of the variation in grades for the 206 examination was accounted for by control of Movement, following imagery enhancement training.

The improved predictive power of post-test imagery ability measures in the imagery training group implies that imagery was utilized to a greater extent in performance as a result of training, as the two training groups did not differ on absolute post-test scores.

8. UTILIZATION OF IMAGERY IN DESIGN PROJECT

Observer ratings

Multiple regression analyses were performed separately for each training group, to examine predictive utility of pre- and post-test imagery, spatial and cognitive style (VVQ) measures for observer ratings of visual imagery utilized in the design project. The results for the Creativity group yielded no significant predictors.

In the Imagery group, post-test VVIQ scores accounted for 27% of the variation in observer ratings of visual imagery utilization ($R^2 = .27, p = .04$).

Self-ratings

Across the sample, self-rating of vividness of visual imagery utilized was significantly related to observer rating ($r = .30, p = .01$) as was self-rating of control ($r = .38, p = .002$), providing some convergent validation for these ratings of imagery utilization. Self-rating (vividness) was not related to vividness ability score

(VVIQ), pre- or post-test, but control rating was correlated with control ability (GCIQ total) post-test, $r = .30$, $p = .02$.

When the training groups are examined separately, the relationships described occurred predominantly in the Imagery group, apart from a significant relationship between observer rating and self-rating of control ($r = .34$, $p = .03$) in the Creativity group. In the Imagery group there was a positive relationship between imagery utilization and ability, for vividness of imagery, but this did not reach significance. Ability to control imagery, as measured by post-test GCIQ total, and perceptual control (Necker) were both positively related to self-rating of imagery control in performance ($r = .42$, $p = .03$; $r = .32$, $p = .08$). The correlation coefficients between observer and self-ratings were much stronger in the imagery group; $.43$, $p = .01$ for vividness and $.42$, $p = .01$ for control.

9. RELATIONSHIP BETWEEN IMAGERY UTILIZATION AND PERFORMANCE

Observer ratings of imagery used in the design project correlated highly with grades obtained ($r = .79$, $p = .000$). Although the training groups did not differ in their self-rating of vividness and control of imagery they identified as relevant in their work, they did differ in the extent to which imagery utilization predicted level of performance (Table 30).

Unexpectedly, self-ratings of imagery utilization in the design project were also significantly correlated with

TABLE 30

CORRELATIONS BETWEEN SELF-RATINGS OF VISUAL IMAGERY
UTILIZED IN DESIGN PROJECT AND PERFORMANCE VARIABLES -
FOR EACH TRAINING GROUP

SELF- RATINGS	DESIGN PROJECT	CREATIVITY GROUP	
		ENGINEERING 205	ENGINEERING 206
VIVIDNESS OF IMAGERY		.37*	.34*
CONTROL OF IMAGERY	.31*	.46**	(.27)
		IMAGERY GROUP	
VIVIDNESS OF IMAGERY	(.29)	.59**	.50**
CONTROL OF IMAGERY		.62**	.58**

* $p < .05$

** $p < .005$

() $p < .08$

level of performance in the Engineering 205 and 206 examinations. This occurred across the sample but with greater strength in the Imagery group (Table 30). Although it is not possible to ascertain from this experimental design the extent to which imaginal processes were involved outside of the design project, the results suggest that when imagery is used in at least some situations, performance level in a range of contexts can be predicted from the vividness and control of imagery experienced. The stronger relationships existing in the Imagery group may reflect more generalized use of imagery following training. If training had resulted in more accurate or valid self-rating of imagery utilization, one would expect higher coefficients in the context of the self-ratings i.e. the design project, than in the independent performance contexts (Engineering 205, 206). On the other hand if demand characteristics were influential, weak or nonsignificant correlations between self-rating and observer rating and also performance level, would be expected.

10. INTERACTIVE EFFECT OF VIVIDNESS AND CONTROL OF IMAGERY ABILITY ON PERFORMANCE

Richardson's (1969) proposition of an interactive effect of imagery vividness and control in some types of problem-solving i.e. an interference effect with vivid, autonomous imagery and enhancement of performance with vivid, controlled imagery, was examined in a 2-way analysis of variance, using distribution means as cutoff points for High and Low groups on imagery ability measures. There were no significant main effects or interactions. Although

imagery ability measures did not predict the mediation pattern suggested by Richardson, the self-ratings of the nature of imagery actually experienced in a specific performance task did predict better performance with highly vivid and controlled imagery. It appears that situation specific measures of imagery are more predictive of performance than more general ability measures and for the particular nature of problem-solving involved in these performance tasks, vivid and controlled imagery resulted in superior performance, supporting one of Richardson's propositions..

11. DIFFERENTIAL EFFECTS OF TRAINING FOR CLEM CATEGORIES

Right-, left-, or bidirectional-movers (CLEM) did not differ on pre- or post-test imagery measures or on performance level. Bakan's (1969, 1980) findings indicating superior visual imaging ability for individuals demonstrating a right hemisphere bias were not supported. Both right- and left-movers demonstrated a change towards more vivid imagery with imagery training (Figure 1). However, CLEM categorization did interact significantly (2-way ANOVA) with training group for:

1. observer ratings of imagery utilization in design project ($p < .05$) (Figure 2)
2. design project grades ($p < .01$) (Figure 3)
3. Engineering 205 ($p < .01$) (Figure 4).

The interactive effect operated in a similar direction on all variables with left movers benefiting most from verbal creativity training, right movers from imagery training and bidirectionals demonstrating little variation

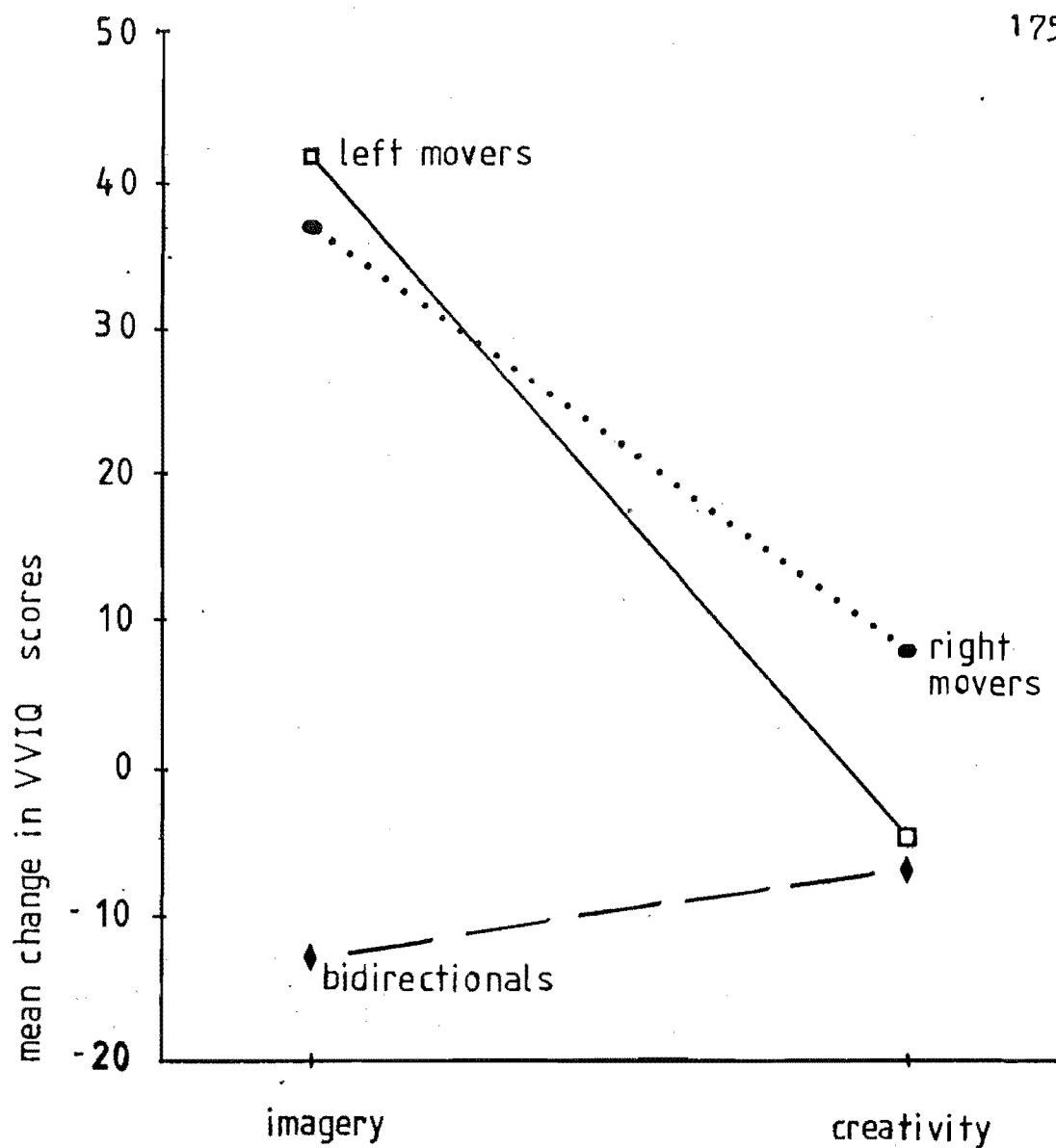


FIGURE 1: Mean change in VVIQ scores as a function of CLEM category and training group

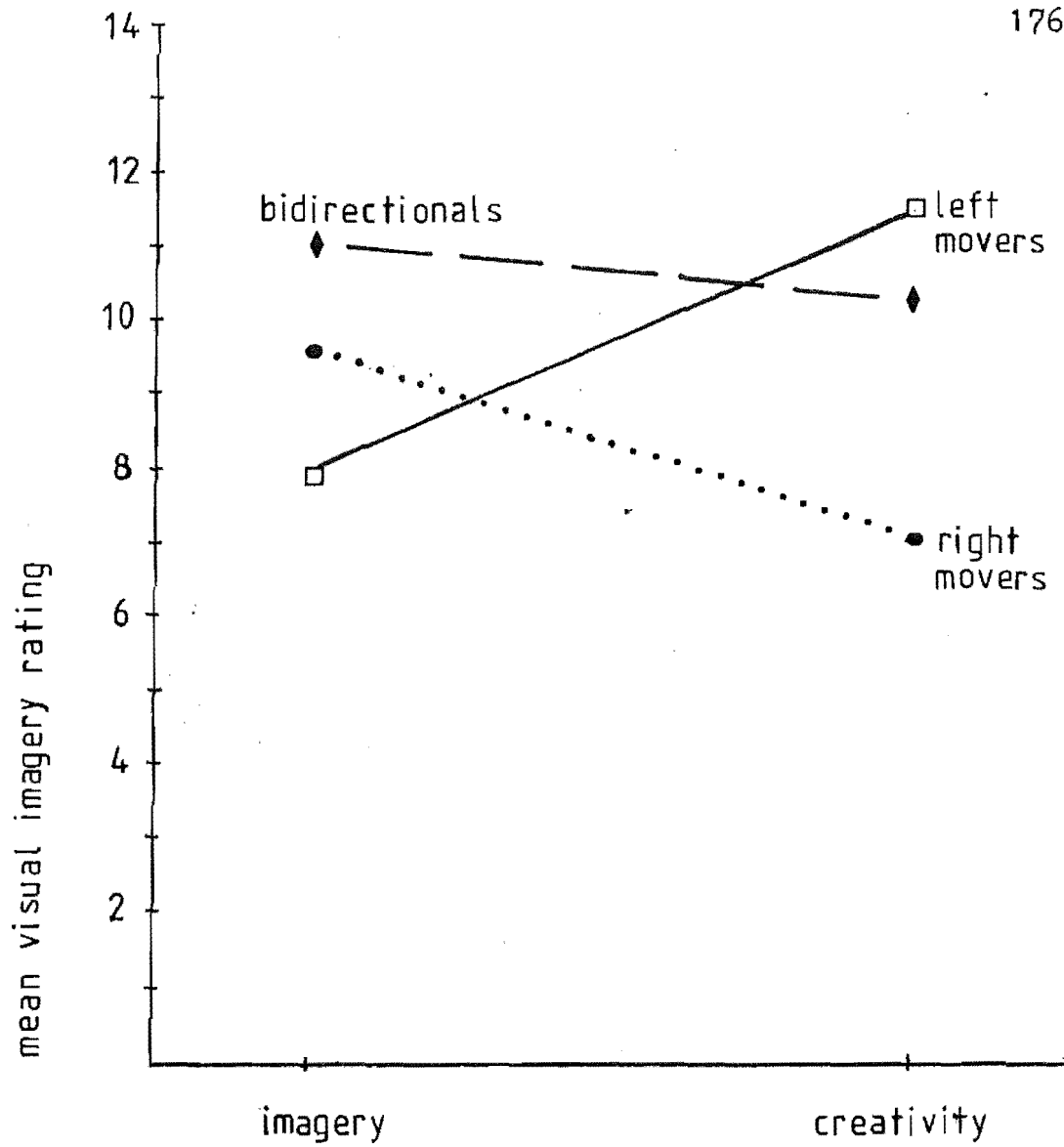


FIGURE 2: Mean observer ratings of visual imagery utilized in design project as a function of CLEM category and training group

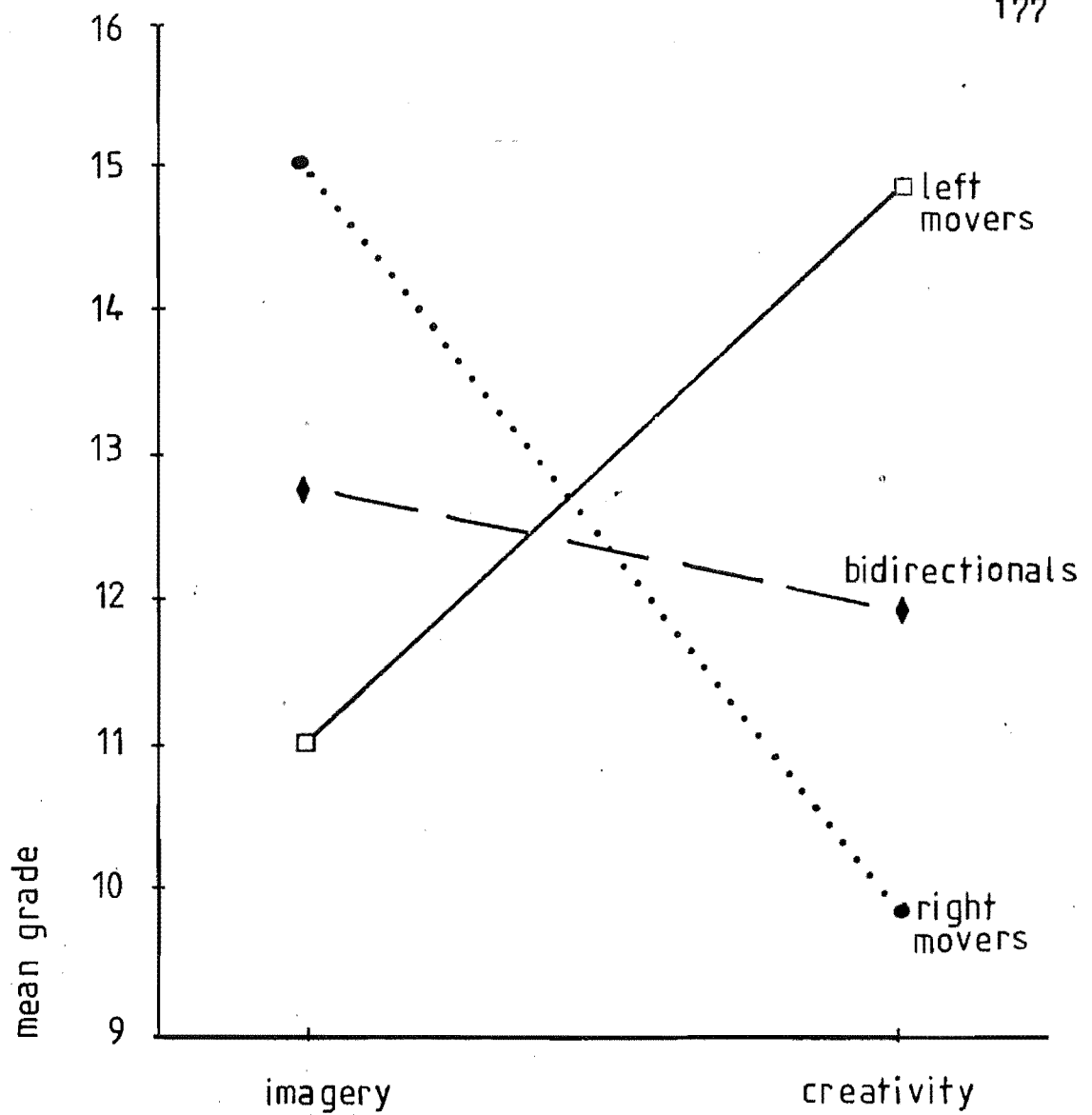


FIGURE 3: Mean grades for design project as a function of CLEM category and training group

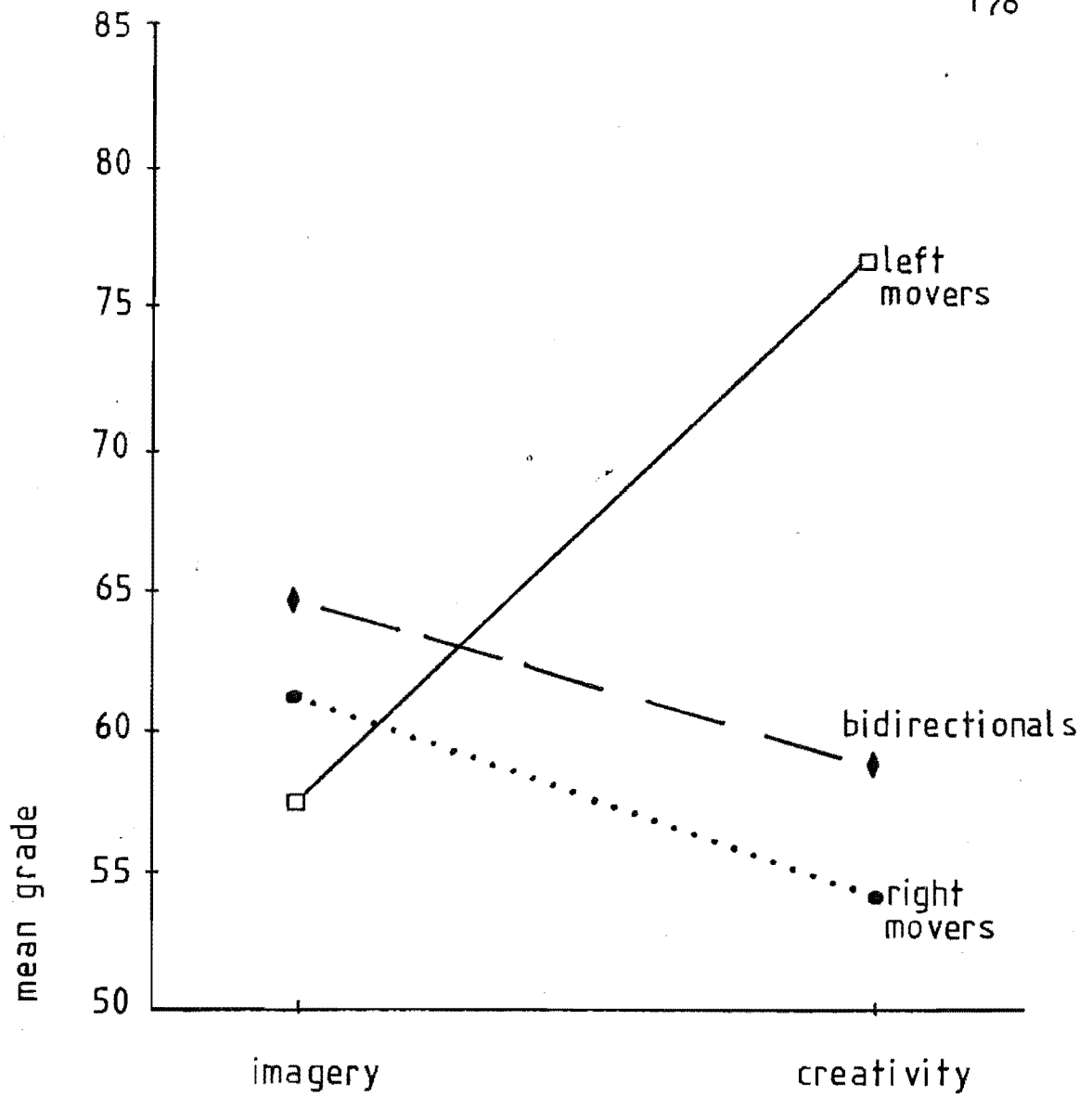


FIGURE 4: Mean grades for Engineering 205 as a function of CLEM category and training group

between training programs. The implication from these results is that training in the nonpreferred processing mode enhanced performance in a range of contexts including imaging utilization.

VVQ cognitive style classification did not interact with training in this manner.

12. OBSERVER RATING OF CREATIVITY FOR DESIGN PROJECT

Observer ratings of creativity demonstrated in the design project were not associated with imagery ability, utilization, cognitive style or performance level.

SUMMARY OF RESULTS AND DISCUSSION

1. RELIABILITY AND VALIDITY OF MEASURES

The internal reliability of the Gordon's Control of Imagery scale has been demonstrated, from the results of the present study and Experiment 1, to be low due to the relative independence of the four subfactors. In addition the subfactors demonstrate differential predictive or functional validity. Similarly to White & Ashton's (1977) results, the Movement factor of imagery control was most predictive of performance on all tasks. Shared variance between control of Movement and perceptual control (Necker) indicates the latter would be valid as an objective measure of imagery control but only in this circumscribed context.

The assumptions underlying the Verbalizer -

Visualizer Questionnaire were not supported generally although a visualizing cognitive style was moderately associated with spatial manipulation. The lack of statistically significant results may be specific to the all male sample, as Richardson's (1977b) studies indicated less internal reliability with males than females, for the VVQ.

The influence of a social desirability response bias on introspective imagery rating scales: The PRI was associated with all imagery measures although the very strong relationship between PRI and control of Movement and Colour was obscured with the total score. This has probably led to the nonsignificant results reported in previous research. However the interpretation of the association between PRI and imagery scales is unclear. A substantial proportion of the shared variation is accounted for by personality correlates which describe creative, self-confident, risk taking individuals. The problem of interpretation appears to lie in the inability of the PRI to discriminate the veracity of favourable self description.

Personality correlates of the VVIQ support previous literature which has ascribed vivid imagery to creative personalities (e.g. Khatena, 1975). However high controllers appear to be of two types 1) adaptable, unpretentious, forthright, easygoing, 2) a more rigid personality style, avoiding risks, seeking stability and security. The second is possibly a more extreme position on a personality dimension associated with highly controlled imagery however it is directly contradictory to previous theoretical descriptions of high controllers being adaptable and

flexible in cognitive and personality style (e.g. Richardson, 1977a).

2. EFFECT OF TRAINING

Both the verbal creativity training program and the imagery training program led to increased vividness of visual imagery ratings and little change in control of imagery except for a small proportion of subjects whose post-test GCIQ scores indicated less control or more autonomous imagery, which was associated with increased vividness. The sample distribution was skewed towards highly controlled imagery to begin with, which may have influenced these results. The changes in imagery ability measures were stronger in the imagery training group. However the results suggest there was also an indirect effect from the verbal creativity program on imagery ability. This may be considered supportive of Ainsworth-Land's (1982) hypothesized model that training in methods associated with creative cognitive processes will induce movement to a higher level of imagery utilization. Additional support for this model which describes higher levels of imagery processes in creative thinking as incorporating autonomous imagery as well as controlled, is offered by decreased imagery control (GCIQ) with changes towards more vivid imagery and utilization of imagery in performance.

Imagery training produced greater interdependence among imagery and spatial ability measures. This suggests more accurate introspective assessment of imagery ability, which was not due to a practise effect or to demand

characteristics according to the results. A strong relationship between vividness and control measures followed training, which refutes the generally held opinion that these dimensions are independent processes.

Imagery training improved the predictive utility of ability measures, demonstrating that in spite of the problematic aspects of absolute imagery rating criteria, imagery ability measures do have considerable predictive validity both within subjects/between stimulus items and between subjects who are influenced by similar experimental conditions. Reports of imagery characteristics during a task were superior in predicting performance than imagery ability measurement prior to a task, as Marks (in press) suggested. Inconsistency in imagery utilization was indicated from the results which clearly limits prediction from the general ability measures, however the subject numbers were too small in this study to perform statistical analyses of personality factors influencing variability. Imagery training did have a positive effect in increasing imaging processing during performance but the functional factors can only be surmised - possibly a result of practice with imaging and the focus on imagery as a mediating process for enhancement of learning and some forms of problem-solving.

Hemispheric bias (CLEM) did not absolutely discriminate response to imagery training although enhancement of imagery ability was stronger among left movers. Distinct lateralization of imaginal processes was not supported by the present results although right

hemisphere functioning as a preferred mode was associated with greater facilitation by imagery training.

Performance on the range of tasks used in this study, which incorporated concrete and abstract processing as well as learning/memory/recall processes, was enhanced by the training programs modified by CLEM category. Training in the non-preferred mode i.e. verbal creativity training with left-movers and imagery training with right movers, resulted in improved performance level. As has been suggested by several writers (e.g. Myers, 1982; Maivardi, cited in Richardson, 1969) utilization of the capabilities of both hemispheres or alternative processing modes appears to be superior to rigid reliance on one cognitive style.

CHAPTER VII

EXPERIMENT 3: ADDITIONAL TOPICS

1. PREDICTIVE UTILITY OF REVISED BEHAVIOUR
DISPOSITION SCALE (BDS)

RESULTS AND DISCUSSION

The sample mean on the Creative Person Scale (ACL) which was used as the cutoff score defining high and low groups for differential scoring of BDS was 47 (standard score). The sample distribution was similar to Experiment 1 on which the revised scoring system was based.

Intercorrelation of BDS subscales

Intercorrelations between subscales were of a similar magnitude and significance level to the previous sample (Experiment 1) except for the Inventive subscale which shared little variation with the other subscales and was unrelated to the Person subscale.

Relationship with imagery ability

As in the previous sample, VVIQ and GCIQ total (pre-test) were not related to BDS. Relationships between GCIQ subfactors and Necker with BDS subscales are presented in Table 31.

Post-test VVIQ scores were positively related to all BDS subscales with the exception of Inventive. GCIQ and Necker post-test scores were also more strongly associated with BDS than pre-test scores.

TABLE 31

CORRELATIONS BETWEEN BDS AND PRE- AND POST-TRAINING IMAGERY MEASURES

	PERSON	EMERGENTIVE	BDS EXPRESSIVE	TECHNICAL	INVENTIVE	TOTAL
VVIQ						
Pre	-	-	-	-	-	-
Post	.37	.42	.45	(.26)	-	.33
GCIQ						
Movement						
Pre	-	-	-	-	-	-
Post	-	.32	-	-	-	-
Misf.						
Pre	-	-	-	(-.23)	-	-
Post	-	-	-	-	-	-
Colour						
Pre	-	(.22)	-	-	-	-
Post	-	-	-	-	.44	-
Stationary						
Pre	-	-	-	-.33	-	-
Post	-	-	-	-	-	-
Total						
Pre	-	-	-	(-.26)	-	-
Post	-	-	-	-	-	.35
Necker						
Pre	-.56	-	(-.21)	(-.25)	-	-
Post	-	-	-	-	-	.31

All correlations $p < .05$ except () indicates $p < .08$

Response bias

Significant correlations occurred between BDS subscales Person, Emergentive, Technical and the PRI (r 's = .34, .28, .32, $p < .05$). This cannot simply be interpreted as a social desirability response bias, considering the shared variation with VVIQ and previous results indicating personality correlates.

Predictive utility of BDS

Low but significant correlations occurred between Total BDS and change in imagery ratings following training: change VVIQ, $r = .25$; change GCIQ $r = .28$; change Necker $r = .24$ ($p < .05$).

Table 32 presents results for prediction of the three performance variables as well as observer ratings of visual imagery utilization and creativity demonstrated in the design project. Differential scoring for High and Low CPS (Person scale) improved the prediction for High CPS on the Design Project, grades, and observer ratings, however scoring the Inventive scale separately for Low CPS added no predictive power to the other BDS subscales. In order to evaluate the utility of including the Person and Inventive BDS scales in the revised scoring system, a total score was calculated for all subjects including only the 3 BDS scales, Emergentive, Expressive and Technical. The resulting correlational coefficients between this total and the performance measures are listed in the final column of Table 32 under Total 2. The predictive power of the BDS total score is virtually identical by scoring only the 3 disposition scales for all subjects. The correlation

TABLE 32
CORRELATIONS BETWEEN BDS SUBSCALES AND PERFORMANCE VARIABLES

PERFORMANCE VARIABLES	BDS SCALES					TOTAL 2 (excl. 1 & 2)
	TOTAL	PERSON ¹	EMERGENTIVE	EXPRESSIVE	TECHNICAL INVENTIVE ²	
DESIGN PROJECT GRADE	.27	.49	.33	.35	.29	.29
OBSERVER RATING OF VISUAL IMAGERY	.30	.38		(.23)	(.25)	.32
OBSERVER RATING OF CREATIVITY	.29	.38		.23		.31
ENGINEERING 205	.51		.29			.51
ENGINEERING 206	.43					.42

¹ scored only for High CPS

² scored only for Low CPS

p < .05 except () indicates p < .08

coefficients between this substantially pared down version of the BDS and performance measures are higher than correlations between the original Taylor's Behaviour Disposition Scale and divergent thinking tasks (Experiment 1). In addition these coefficients are higher than the commonly obtained range for validation of other creativity measures. Although the only performance measure specifically assessing creativity was the observer rating for the design project, the BDS predicted performance moderately well across a range of "real-life" contexts which would include cognitive processes considered to contribute to creative production e.g. vividness of imagery, utilization of visual imagery, conceptual thinking, (mechanical) design, communication of product. The BDS appears to be a useful creativity measure with external validity, but for predictive purposes the original scale appears unnecessarily complex and redundant. Although very specific cognitive processes or qualitative aspects of performance may be more highly associated with a single BDS subscale, as indicated in Experiment 1 with TTCT submeasures, assessment of Emergentive, Expressive and Technical dispositions is a parsimonious, brief and useful measure of creative performance (at least in the areas focused on in Experiments 1 and 3).

2. PERSONALITY CHARACTERISTICS ASSOCIATED WITH LATERAL EYE-MOVEMENT PATTERNS

In order to compare personality determinants of characteristic trends in inferred hemispheric utilization, in two independent samples, the data from subjects in

Experiment 2 were reclassified and reanalysed. Subjects were classified as right-, left-, or bidirectional-movers based on the criteria outlined in the methodology section, although the original recording of eye movement varied from the present sample in using initial eye gaze, as described. In the interim period between Experiment 2 and 3, consideration of recent research in this area and observation of the ocular behaviour of the first set of subjects, prompted the modification of the categorization system to include bidirectional movers.

Stepwise discriminant analyses were conducted with each sample. The ACL scales comprised the discriminate variables. The results of the analyses for the engineering sample including the seven subjects who appeared to be distracted by the asymmetry of the visual field (distractor in the left visual field as described in methodology), are summarized in Tables 33 & 34. Function 1 was significant in its discriminatory power ($p = .002$) and the two functions together correctly classified 69.6% of the subjects. Least accurate classification was for left-movers, 40% being misclassified, and next for right-movers, 33% being misclassified. Although some of the personality characteristics are similar to those from Experiment 2 for the CLEM categories (Table 37), the dimensions identifying left and right movers include ACL variables which appear incongruous and even reversed for these groups. As with the psychology student sample left-movers were more emotionally labile, nonconforming and ambitious but they were also described in this analysis as logical and analytical in cognitive style which would be associated more with right

TABLE 33

DISCRIMINANT FUNCTION COMPOSITION -
ENGINEERING SAMPLE, ANALYSIS INCLUDING "DISTRactable"
SUBJECTS

Checklist Scales	Standardized Coefficients	Function	X ²	P
Personal adjustment	- 1.22	1	23.64	.002
Low origence - High Intellectence	1.00			
Intraception	.75			
Communality	- .49			
Intraception	- .95	2	5.24	.15
Low origence - High Intellectence	.88			
Communality	.78			
Personal adjustment	.06			

Percent correctly classified by discriminant functions =
69.6

TABLE 34

Personality Characteristics Identifying CLEM Subgroups
from Adjective Checklist Scales Primarily Representing
Discriminant Dimensions - Engineering Sample, including
"Distractable" subjects

Left movers	<p>Logical, foresighted, ambitious, complex, conscientious.</p> <p>Interests narrow, superstitious, informal, enthusiastic.</p> <p>Unpredictable & changeable in behaviour & attitudes, rebellious, non-conforming.</p>
Right movers ¹	<p>Anxious, moody, defensive, worry about ability to deal with stress, shy.</p> <p>Dependable and responsible, value intellectual & cognitive matters, fastidious, objective, rational. ambitious, moralistic.</p> <p>Unpredictable & changeable, rebellious, self-centred.</p>
Distinct group of ¹ bidirectionals	<p>Initiators, positive attitude, industrious, productive.</p> <p>Self-satisfied, social poise, reliable, considerate of others.</p> <p>Informal, enthusiastic, candid, interests narrow, superstitious.</p>
Overlapping group of right-movers & bidirectionals	<p>Self-defeating, self-pitying, apathetic, interests narrow, difficulty dealing with stress.</p> <p>Intellectual, objective, rational.</p>

¹ Discriminatory power of functions identifying these
groups was significant.

movers according to previous literature. Similarly the description of right movers as anxious and moody is not only a reversal of Experiment 2 results but again is contradictory to the literature on lateralization of emotion. A contrasting result in terms of personal adjustment occurs between the two samples for the overlapping group of right movers and bidirectionals.

Reanalysis, excluding the seven "distractible" subjects resulted in highly significant discriminant functions (Table 36), a highly successful classification percentage (89.7%) and particularly improved for left-movers (75% correctly classified) as well as replicating many of the theoretically meaningful personality descriptors from Experiment 2. Although determinants of ocular behaviour other than hemispheric activity most certainly influence CLEM categorization with all subjects, the distraction in the external environment in Experiment 3 seems to have prevailed over characteristic response style with the seven subjects and consequently confounded to some extent the discriminative dimensions. The remaining results and discussion will deal only with the remaining subjects in the engineering sample after exclusion of these few individuals as it appears that the results are more representative of individual differences in eye-movement patterns. Table 35 outlines sample distributions of CLEM categories.

In the psychology group (Experiment 2), the first dimension derived (Function 1) demonstrated significant discriminating power and was primarily represented by personal adjustment. This dimension separated left movers

TABLE 35

Sample Distribution of Conjugate Lateral Eye Movement
Classification and Sex

Sample	Left movers	Right Movers	Bidirectional	Totals
Psychology				
Males	5	15	10	30
Females	1	11	12	24
Totals	6	26	22	54
Engineering				
Males	8	9	22	39
Females	-	-	-	-
Totals	8	9	22	39

TABLE 36
Discriminant Function Composition

Checklist scales	Standardized Coefficients	Function	χ^2	P
Psychology Students ^a				
Personal adjustment	-.99	1	24.58	.01
Dominance	.66			
Low origence- Low intellectence	.55			
Autonomy	.37			
Unfavourable	.35			
Self-confidence	-1.56	2	7.33	.19
Autonomy	.89			
Low origence- low intellectence	.74			
Dominance	.68			
Unfavourable	-.58			
Personal adjustment	.32			
Engineering students ^b				
Autonomy	2.36	1	64.83	.0000
Favourable	2.30			
Order	-2.04			
Self-confidence	2.01			
Change	-1.61			
Low origence- high intellectence	.93			
Dominance	1.39	2	28.47	.0008
Autonomy	-1.25			
Order	-1.23			
Personal adjustment	1.17			
Unfavourable	.92			
Self-confidence	.89			

^a Percent correctly classified by discriminant functions = 51.9

^b Percent correctly classified = 89.7

TABLE 37

Personality Characteristics Identifying CLEM Subgroups from
 Adjective Checklist Scales Primarily Representing
 Discriminant Dimensions and Most Frequent Adjectives Used -
 Psychology Sample

Left movers	<p>Anxious, high-strung, moody, avoid close relationships, worry about ability to deal with stress.</p> <p>Strong-willed, ambitious, not inhibited by disapproval, power oriented.</p> <p>Rated themselves most frequently as cheerful, healthy, sensitive, discreet, cynical, opinionated, rebellious. Shrewd.</p>
Distinct group of right movers	<p>Difficulty mobilizing resources and taking action, others see them as shy, inhibited, withdrawn, ambitious.</p>
Distinct group of bidirectionals	<p>Initiators, assertive, enterprising, self-confident, productive.</p> <p>Described themselves most frequently as honest, considerate, dependable, healthy, friendly, sensitive, determined.</p>
Overlapping group of right movers and bidirectionals	<p>Positive attitude towards life, enjoy company of others, feel capable of initiating activities and achieving goals, self-confident and self-satisfied.</p> <p>Non-competitive, sensitive to criticism, modest, gentle, avoid risks.</p> <p>Described themselves most frequently as calm, friendly, cooperative, reliable, dependable, responsible, healthy, independent, curious, adaptable, active, wide interests.</p>

TABLE 38

Personality Characteristics Identifying CLEM Subgroups
from Adjective Checklist Scales Primarily Representing
Discriminant Dimensions and Most Frequent Adjectives Used
- Engineering Sample

Left movers	<p>Anxious, moody, introspective, insecure, inhibited, overcontrolled, worry about ability to deal with stress, unpredictable.</p> <p>Power-oriented, ambitious.</p> <p>Aesthetically reactive, sensuous, tend to fantasize and daydream.</p> <p>Warm, compassionate.</p> <p>Rated themselves most frequently as cheerful, appreciative, wide interests, practical.</p>
Distinct group of right movers	<p>Lack confidence, defensive, non-competitive, skeptical, cautious, distrustful of others, moralistic.</p>
Distinct group of bidirectionals	<p>Leaders, initiators, assertive, self-confident, determined, productive.</p> <p>Humorous, adventurous.</p> <p>Somewhat dissatisfied, headstrong, changeable.</p> <p>Described themselves most frequently as honest, considerate, friendly, adaptable, ambitious, intelligent, active.</p>
Overlapping group of right movers and bidirectionals	<p>Self-confident, social poise, independent, autonomous, assertive, self-willed, ambitious.</p> <p>Dependable, responsible, emotionally bland.</p> <p>Analytic, logical, self-disciplined.</p> <p>Described themselves most frequently as logical, fair-minded, dependable, reliable, capable, conservative, forgiving.</p>

and an overlapping group of right and bidirectional movers. Function 2 was of lesser discriminating power but served to separate a subgroup of right movers from bidirectional movers. This dimension was characterized predominantly by self-confidence. Classification of group membership by the personality dimensions derived was moderately successful; 51.9% of subjects were correctly classified.

The discriminant functions produced for the engineering sample included ten Checklist scales. However, only those most representative of the two dimensions are documented in the summary table. Both of the functions demonstrated a highly significant degree of discriminating power. Function 1 separated left movers from a combined group of right and bidirectional movers. The second dimension distinguished most clearly between right movers and a subgroup of bidirectional movers. Subject classification, in terms of the two dimensions, was highly accurate with 89.7% correctly classified.

Personality summaries for the Adjective Checklist scales identifying each eye movement group, together with the most frequent adjectives checked, appear in Table 37 (psychology students) and Table 38 (engineering students).

DISCUSSION

The distribution of characteristic lateral eye movement direction, in each sample, included a substantial proportion of bidirectional movers which supports Ehrlichman

& Weinberger's (1978) results but is contrary to earlier studies which found unidirectional consistency more pervasive (Day, 1964; Bakan, 1971). It seems reasonable to expect distribution characteristics to be determined largely by the population sampled and procedures followed. A rather surprising finding in the present study was the equivalent proportions of right and left movers among the engineering students, considering the number of studies which have found differences between right and left movers in their "hard" or "soft" academic interests (Bakan, 1971; Combs et al., 1977; Katz & Salt, 1981).

Interpretation and generalization of the present results must be cautious due to the small numbers of unidirectional movers in each sample and the unequal sex distribution in the psychology group. However, there are close parallels in the obtained personality profiles in spite of confounding variables, varying academic fields of study and methodological differences. The greater accuracy in discriminating eye movement groups, among engineering students, may reflect improved reliability for the modified scoring system. Alternatively the relationship of lateral eye movements to personality dispositions may be stronger in males than females, as suggested by Woods (1977), which would sharpen the distinction in the all-male engineering group.

Support is offered for the functional significance of conjugate lateral eye movements in examining asymmetry of personality and cognitive style variables by:

- (1) convergent validation of characteristic personality profiles provided by independent samples and methodological differences
- (2) the degree of accuracy in discriminating groups in terms of self-reported personality and cognitive style variables
- (3) the consistencies between the present findings and previous research, particularly the literature on lateralization of emotion.

Left movers were clearly distinct from other subjects in terms of personality variables. They were identified most strongly in each sample by personal maladjustment and emotional lability. The personality style indicated has many negative facets but the adjectives most frequently checked also indicate a self-awareness and honesty in their self-description, recognition of positive and negative attributes. This implies an independence in self-evaluation from social approval. However a high degree of emotional lability appears to create internal conflicts which may interfere with performance or productivity. The lateralization of anxiety emotions and symptomatology to the right hemisphere (Table 22 for references) fits neatly with the personality style described for left movers. Previous research on individual differences with CLEM categories (Table 22) is largely supported from the present results e.g. Libby & Yaklevich's (1973) finding that left movers tend to focus on internal experiences, are more emotional and internalize conflicts. One might expect this group's labile and non-conforming nature to be more suited to free and impressionistic performance conditions as Sackeim,

Packer & Gur (1977) found.

A subgroup of consistent right movers, in both samples, also demonstrate some maladaptive personality characteristics which would interfere with actualizing the ambitions this group of individuals (from the psychology sample) ascribes to themselves. They are identified predominantly by insecurity and inefficacy in interpersonal and intellectual areas.

A heterogeneous group of right movers and bidirectionals were identified in both samples as similar on the personality dimensions derived. The unidirectionality of eyemovements for the right movers in this group appears to be influenced more strongly by factors other than lateralization of personality/emotions/cognitive style than the bidirectional subjects. One hypothesis for this could be a developmental influence of the education system emphasizing left hemisphere processing styles. The personality style shared by this overlapping group is that of a sociable stable person who is productive and satisfied with life. Self-description is in terms of social virtues and a high value is placed on the opinions of others. A tendency to avoid risk is evident and there is the suggestion of cognitive rigidity. Extrapolating from these characteristics some indirect support is suggested for Sherrod's (1972) finding that right movers are more susceptible to persuasion. These individuals would probably feel more comfortable in situations requiring organization and precision, as suggested by Sackeim et al's (1977) results. An active, external orientation, which Gur & Gur

(1975) found for right movers in relation to defense mechanisms, is indicated by the self-descriptors.

Bidirectionality is associated with the greatest degree of personal adjustment, cognitive flexibility and productivity in these two samples. The personality style closely resembles the "creative personality" which has been described from extensive empirical investigation (MacKinnon, 1978). These individuals possess the positive interpersonal and intellectual qualities but also appear to have the personal drive, initiative and determination required to achieve creatively. They appear more flexible and adventurous which may sometimes be based on dissatisfaction but these qualities are often necessary for creative breakthroughs, fueling the search for new alternatives. Some illogicalities or paradoxical combinations occur in the profiles, with respect to active/passive, socially affiliative, dependable/autonomous, independent type dimensions. These "paradoxes" are reminiscent of creative personality findings (McMullan, 1976; MacKinnon, 1978).

The association between personality characteristics and inferred hemispheric lateralization raises a host of hypotheses concerning the causal nature of the relationship. Research on lateralization of positive and negative emotions, cognitive processing style and relative efficacy of processing style in particular contexts contribute to a developmental view of the personality correlates. Alternatively, could personality styles determine the preference or consistency of information processing style utilized? To what extent are subject strategies and

hemispheric allocation voluntary? Resolution of the controversial issues in hemispheric specialization theory is necessary before these questions can begin to be answered.

However, conjugate lateral eye movement assessment appears to be a valid research tool in the study of individual differences in hemispheric utilization. Future research should identify and include bidirectional movers in addition to unidirectional movers, and attempt to clarify the characteristics and conditions which distinguish these individuals.

CHAPTER VIII

IN CONCLUSION

In this final chapter the experimental design and methodology utilized is critically evaluated. Limitations and shortcomings which were apparent to the experimenter will be enumerated and where appropriate, suggestions made which might resolve these problems. Following this a model of creativity is proposed and discussed.

1. EMPIRICAL LIMITATIONS

a) Experiment 1. The intention in Experiment 1 was an exploratory investigation of a wide range of person, process, environmental, and to a minor degree product, variables in a sample representing a variation in ability and achievement levels. The pluralistic focus entailed a number of methodological and statistical problems, varying in their impact on the results.

The time involvement required of subjects in completing the assessment measures as well as the duration of this involvement imposed a burden on subjects' cooperation and enthusiasm not usually encountered in single administration surveys or experimental designs. Although the sample was randomly selected initially, a dropout rate of approximately 25% occurred, not high compared to that typical of survey designs, but nevertheless resulting in a biased sample. The confound introduced might be inferred as motivational and/or compliancy, both of which would have important implications for data interpretation. A number of

these subjects however were forced to leave the study for nonpersonal reasons such as sabbaticals, termination of employment, illness which hopefully counterbalanced the motivational bias somewhat. The sample was considered to represent a wide distribution on the variables measured, which was confirmed in the data, however selection from a single institutional setting places some constraints on external validity and generalization of the results to other populations.

The interest in naturally occurring environmental influences on creative behaviour necessitated subjects completing the TTCT tasks on their own in an uncontrolled situation. Detailed instructions were given as to the time limits for each task and the environment in which it was to be completed, however systematic control of these factors was not possible and certainly this would affect standardization as well as limiting strict comparability to previous studies which have used a group format and controlled conditions of administration. These problems were recognized prior to designing the study but were accepted as a confounding influence which would be partially controlled by randomization of sample selection and experimental conditions as well as partially explained by assessment of a range of personality and environmental perception variables.

The focus on the variety and complexity of variables associated with creativity was to the detriment of thorough, in-depth investigation of some aspects. This applies particularly to productivity, measured only for a subgroup

(academic staff), and the criterion chosen. The problems inherent in previous product ratings were prominent in the desire to select an objective measure. A pilot attempt to obtain peer ratings of product creativity level was unsuccessful due to reticence on the part of subject raters. Consequently this tack was not pursued and productivity, defined only in terms of quantity without qualitative assessment, was relegated to a position of minor importance in the study.

Using multivariate statistical analyses with a relatively small sample ($N = 70$), the ratio of predictor variables to sample size was inevitably quite high in particular analyses, which introduces concern about the possible inflation of the correlation coefficients. Sampling error estimates were scrutinized, however cross-validation in another sample might produce lower magnitude relationships. Although the same concern was inherent in Experiments 2 & 3, the generally parallel ranking and weighting of personality variables in discriminant analyses for CLEM categories, in independent samples, provides support for the validity of the results. In multivariate analyses which appeared questionable, bivariate analysis was carried out to crosscheck for spurious results. The sample size also restricted more detailed analyses of some specific interactions which emerged, were of theoretical interest, but subgroupings were too small.

Selection of variables for examination in Experiment 1 was limited by the measurement instruments available, and

the reliability and validity evidence for these, balanced against the various areas of interest and the time commitment for subjects. The Creative Person Scale has received substantial support in the literature for its discriminative power in identifying creative achievers. However, it is an empirically derived scale and lacks underlying theoretical assumptions. This creates difficulties for interpreting empirical relationships with instruments such as the Behaviour Disposition Scale which was developed from a clear theoretical perspective, possesses face validity but unsubstantial empirical validation, either of its discriminant power or construct validity. In this investigation and Experiment 3, the theoretical assumptions of the BDS were cautiously accepted for interpretive purposes while empirically evaluating its predictive utility. Further research is required on this aspect and is considered important as the instrument demonstrated some predictive power and there is a dearth of measures of creative orientation with such a multidimensional nature.

Similarly, limitations of the visual imagery ability measures, in terms of construct validity, became evident following the initial results e.g. independence of subfactors of GCIQ; inadequate imagery typology to account for low scores on this measure and for interactive positions on control and vividness dimensions. These instruments were utilized in further experimentation in order to followup implications from the initial results, and because they have received more evaluative investigation and empirical support than alternatives. In retrospect, additional dimensions of

imagery, which have been theoretically proposed in the literature, could have been identified and would have assisted in describing a typology and interpreting the results. Although standardized instruments do not, as yet, exist for these, operational definitions and measures could have been devised based on distinguishing criteria e.g. discrimination of vivid, or controlled eidetic imagery from memory imagery might have been made with respect to direction of attention (outwards or inwards), localization in visual space, richness and clarity of detail, motion, among other criteria (Ahsen, 1977).

b) Experiment 2. The design of Experiment 2 involved several tentative methodological procedures which may have contributed to the lack of clear experimental effects for the hypothesized involvement of preconscious processing in intuitive problem solving.

It is believed that the subliminal stimuli (clue and self-statements) were presented in a technically precise manner which should have ensured registration according to extensive empirical work by others (e.g. Dixon, 1971, 1981). However several methodological sources of error which may have been operational, will be discussed.

The subliminal manipulation of self-expectations required comprehension of the semantic context of a phrase consisting of five or fewer words. Semantic encoding of subliminally presented individual words and pictures has been demonstrated with experimentally obtained physiological, psychological and behavioural effects (see

Dixon references for review). However the only work involving semantic comprehension of phrases, that this writer is aware of, has been carried out in a psychoanalytic framework. Silverman and colleagues (1966a,b; 1968, 1972) have been figureheads in this area of research which can be categorized in two contexts: verifying premises of psychoanalytic theory and alleviation of symptomatic behaviour. Demonstrations of behavioural responses which vary according to message content have been replicated in an impressive array of subject samples, structure of the messages and across different experimenters which offers some support for semantic encoding.

The phenomenon of perceptual defense, identified by the influence of conflict areas and emotive subliminal stimuli on perceptual thresholds (Dixon, 1981) spawns hypotheses concerning the degree of threat which the negative statements would hold for some subjects, possibly blocking registration of the subliminal stimuli. From the experimental results it appeared that the only subjects who responded to the expectational statements were those who did, on occasion, experience effortless intuitions and consequently may be more receptive, in general, to this source of perception and less demonstrative of perceptual defense.

The total absence of effect for the problem clue may have been due to its inadequacy as a clue, it lacked the requisite information to "bridge" the mental association. Presentation of the clue solely in a pictorial mode may have prejudiced those subjects who characteristically process

information in a verbal/analytic style, diffusing the statistical effect. In addition, the timing of the clue may have been inappropriate or irrelevant for this type of problem. As mentioned in the literature review on intuition (Chapter IV) experiments to date have used logical reasoning problems which offer easier guidelines to missing information and sequencing of information necessary for solution.

The sparse empirical literature on incubation has focused on elucidation of the processes involved and consequently factors such as length of time away from the problem and subject activity during this time, have been controlled. In the present investigation there was no control placed on these factors. Subjects were blind to the focus on incubation and were left to their own inclinations during a 24 hour period. This was intentional in order to maximize the emergence of individual differences in the nature and experience of problem solution. As with Experiment 1, the only constraint on subjects following instructions outside of the experimental condition, was encouragement and may not have been effective. Self-ratings of the nature of the solution, in terms of effort and prior awareness of relevant cogitation, have not been utilized in previous studies. Nisbett & Wilson's (1977) contention that individuals are unable to introspect on their cognitive processes accurately but instead base their reports on a priori, implicit causal theories, is of particular importance here. Considering the apparent significance of effortless experiencing to the study of intuition, future research would do well to compare the validity of

self-ratings of conscious effort in a situation-specific context to generalized measures of effortless experiencing such as Bowers (1978).

c) Experiment 3. In Experiment 2 and 3, the measurement and scoring of conjugate lateral eye movements differed, with refinements in the latter study taking into account several of the possible sources of error outlined by Ehrlichman & Weinberger (1978). However more detailed measurement of length and degree of movement was not incorporated. The influence of these variables in individual differences study has not yet been established but may well account for unexplained variation in the results. The distracting elements in the visual field were unfortunately recognized too late to rectify.

Comparison of results obtained in Experiment 1 and 3 can only be made conservatively with full awareness of the differing conditions for administration of the common measures. Subjects in Experiment 3 had much more personal contact and interaction with each other and with the experimenter throughout the study, which may have magnified a possible Hawthorne effect. The use of a social desirability measure in the initial experiment would have allowed this influence to be examined to some extent, although the construct validity of Crowne & Marlowe's Personal Reaction Inventory as a measure of social desirability response bias has been demonstrated as precarious and alternatives are noticeably absent.

A similar source of internal invalidity may have been

introduced through the use of a staff member in the Engineering Dept. as the instructor of the verbal creativity training program, someone who had fairly regular contact and a position of authority with the subjects. As one check on this, attendance records were kept and "number of sessions attended" was related as a variable to training results, with no significant effect. The only means of evaluating involvement and motivation, even with attendance, was through analysis of individual differences in the training results on performance.

A major problem with this final study was the subjectivity and inferential basis for development of the imagery training program - and the mélange of procedures within it, which does not permit identification of the functional features. This seemed unavoidable because of the virtual lack of published work on imagery training, or if relevant procedures have been incorporated into creativity enhancement programs they only possess face validity. Maintenance of the students' involvement and cooperation of the Engineering Dept. was weighed against the exploratory aim of this thesis, in deciding not to design a longer program which would allow isolation of each procedure, its theoretical assumption and evaluation of its effect. However, until this type of evaluation is conducted, interpretation of training results remains conjectural.

Pursuit of the second goal in Experiment 3 i.e. validating the revised version of the BDS in a socially relevant context, was impeded by the resultant inadequacy of the sole specific criterion of creativity, the observer

ratings of the design project. The creativity criterion scale presented some difficulties in design, not only in translating and moulding standard dimensions for creative product assessment to mechanical engineering language and project requirements, but due to the level of university training of the sample. At this introductory stage, academic assessment is concerned more with evaluation of retention and application of traditional concepts and principles than with innovation, and in fact this can be conceived as the "preparation" stage of learning necessary before adaptive innovation is possible. In order to adequately assess the predictive utility of the BDS and also the differential effects of training, more valid creativity criteria (construct and external validity) would be essential.

2. A THREE LEVEL MODEL OF CREATIVITY

A model of creativity has been formulated, comprising three levels and based on an overview and integration of the experimental results. In proposing this model, a departure from an empirical framework has been made with a degree of selectivity, extrapolation and integration of empirical findings from independent, non-comparative samples, differing on variables which may possibly be significant to the model propositions e.g. age, career advancement. In addition, varying measurement instruments, experimental designs and a number of unmentioned and unrecognized sources of variability do not allow confident conclusions from a synthetic perspective. However, the model is proposed from a heuristic disposition, with awareness of the empirical

limitations but also a degree of security that the content is supported from a range of perspectives in the empirical results and that the interpretations and implications are not directly contraindicated. A summary of experimental findings which directed formulation of the model, follows.

A SUMMARY OF EMPIRICAL FINDINGS RELATING TO "LEVELS OF CREATIVITY" MODEL

LEVEL 1

Experiment 1 - low scorers on CPS consistently poor on TTCT subtests

- effect of instructions to "Be Creative" on performance of low CPS group & situational influences
- relationship between low CPS and BDS highest for Technical subscale
- uncreative/productive self-concept group obtained lowest scores on all TTCT subtests except Articulateness

Experiment 2 - vivid, autonomous visual imagery associated with lower fluency and originality scores (TTCT), suggesting typology of rigid, stereotyped images; instructions to Be Creative resulted in poorer TTCT performance

- personality descriptors of extreme right- and left-movers (CLEM) similar to subjects unable to solve insight riddle

LEVEL 2

Experiment 1 - high scorers on CPS performed consistently better on Verbal TTCT; situational variability decreased with instructions to Be Creative; performance influenced by environmental perception

- in word association task, originality of associations correlated more strongly with verbal divergent thinking than did opposite responding tendency or rapid opposite responding
- BDS, a measure of creative orientation, was negatively related to TTCT performance
- Verbal TTCT performance enhanced by Be Creative instructions only in work environment
- self-concept of creative/productive explained predominantly by education level, age, information-seeking behaviour, verbal divergent thinking
- among Academic subjects, those who classified themselves as creative/productive overvalued their productivity in terms of a socially recognized measure of achievement
- inconsistency in utilization of imagery; for vivid, controlled imagers, the strength of relationship between imagery ability and figural divergent performance was increased with instructions to Be Creative
- control of Colour subfactor significantly

related to Verbal fluency and originality

~~in-normal instruction group~~

- opposite responding related to vivid imagery
but rapid opposite responders scored lower
on Control

Experiment 2 - personality descriptors of succesful insight
problem-solvers who obtained the solution
with conscious problem-solving activity
and high ratings of effort, similar to
personality profiles of overlapping group
of right-movers and bidirectionals (CLEM)

- a subgroup of subjects who demonstrated
ability to solve insight riddle responded
to manipulation of self-concept relating
to expectations of success (positive and
negative subliminal statements)

Experiment 3 - personality descriptors of high scores on
control of imagery defined two types

LEVEL 3

Experiment 1 - self-concept group creative/unproductive
demonstrated superior ability on all TTCT
subtests in both environments, associated
with high scores on CPS; accurately
evaluated creativity, but in Academic
group tended to undervalue productivity in
relation to publications

- rapid opposite respondng associated with high
scores on figural TTCT and self-concept as
creative
- BDS Person subscale, a measure of creative

orientation and tendency to shape environment, had predictive utility only for high CPS scorers, predicted figural and verbal divergent performance, with correlation coefficients of very high magnitude

- self-concept group creative/unproductive perceived their home environment significantly differently to other groups in terms of structure, spontaneity, expressiveness, orientation
- high figural TTCT scores had more vivid imagery than high verbal
- creative/unproductive self-concept group demonstrated more vivid imagery while creative/productive group had slightly more controlled imagery
- high BDS scorers, who had vivid, autonomous imagery, utilized imagery in TTCT performance when instructed to Be Creative

Experiment 2 - intuitive, effortless experiencer benefited from an incubatory period; the majority were not susceptible to experimental manipulation of attitude, expectations; personality identifiers similar to CPS scale

- effortless experiencing was not associated with hemispheric biases, although does appear to be facilitated by right hemisphere processing

Experiment 3 - CPS scale only personality descriptor of

significance with vividness visual imagery variable

- visual imagery training resulted in increased interdependence among imagery and spatial ability measures; increased vividness which was associated with lower control
- following imagery training, control of Movement subfactor related to level of performance on the three dependent variables, although there was no difference between training groups on post-test GCIQ scores
- situation specific measures of imagery utilized in performance more predictive than imagery ability measurement; utilization of imagery in one context associated with improved performance in other areas
- training in the nonpreferred mode, as identified by CLEM, associated with improved performance across a range of contexts

The model is conceived as three broad levels of creativity (refer Table 39). These are described in terms of cognitive style and creative abilities, imagery ability and imaginal processes, situational influence and motivation, and personality characteristics associated with each level. The overriding conceptualization is in terms of creative ability potential and influences on utilization of potential in creative behaviour.

TABLE 39
A THREE LEVEL MODEL OF CREATIVITY

LEVEL 1	
DESCRIPTIVE DIMENSIONS	
Cognitive style and cognitive abilities associated with creativity	<ul style="list-style-type: none"> - rigid & extreme hemispheric bias, either left or right - limited in creative ability potential although may demonstrate isolated subabilities <u>e.g.</u> original ideation - simple and prosaic cognitive style - order, structure, closure required - concerned with detail, technical skill rather than intellectual matters
Imagery ability and imaginal processing	<ul style="list-style-type: none"> - two types: 1) vague, illusive or apparently non-existent visual imagery 2) vivid but stereotyped, inflexible imagery, may be autonomous, intrusive and interfere with problem solving activity
Situational influence	<ul style="list-style-type: none"> - situational variability in creative performance is minimal, limited by capabilities, however performance may improve somewhat in a structured environment where task demands are clearly defined; consequently instructions which disambiguate demands may enhance - for less structured tasks <u>e.g.</u> figural as opposed to verbal divergent thinking, motivating instructions may be threatening to self-concept and suppress performance
Personality characteristics	<ul style="list-style-type: none"> - emotionally either over-controlled, bland or anxious, moody, unpredictable, difficulty dealing with stress - in relationships with others tendency to be submissive, dependent; a conforming, non-competitive nature; seen by others as shy, inhibited, unexpressive, lacking self-confidence; or may be ambitious, power-oriented, strong-willed, moralistic - emotional type (1) has minimal sensory awareness & introspective tendency (2) is introspective, tending to fantasize & daydream, is aesthetically reactive - conservative, impersistent, difficulty mobilizing resources & taking action, highly uncomfortable with uncertainty and complexity - does not see self as creative

TABLE 39 cont.
LEVEL 2

DESCRIPTIVE DIMENSIONS

Cognitive style and cognitive abilities associated with creativity	<ul style="list-style-type: none"> - hemispheric bias not as rigid as Level 1, although tendency towards left hemisphere processing and verbalizing style - logical, analytic; perception & encoding of information directed by conscious attention and at a semantic level - high level & range of creative abilities but facility and utilization limited in scope <u>e.g.</u> associative ability limited to semantic characteristics as in verbal divergent thinking, opposite responding tendency, remote associates - may possess intuitive ability in the sense of problem solving based on limited or unclear information but characterized by concentrated effort, conscious mental processes, discernable steps
Imagery ability and imaginal processing	<ul style="list-style-type: none"> - imagery vivid and controlled - utilization of imaginal processes inconsistent; preference towards verbal, abstract processes even if less adaptive
Situational influence and motivation	<ul style="list-style-type: none"> - considerable situational variability in creative performance due to variable utilization of abilities, which may be task specific, influenced by self efficacy concept, previous experience - situational factors may facilitate or suppress creative behaviour - motivation tends to be pragmatic, based on external sources <u>e.g.</u> quantitative vs. qualitative, social recognition, utility
Personality characteristics	<ul style="list-style-type: none"> - self-disciplined, calm, positive attitude, controlled impulses, objectivity sought - sociable, friendly, cooperative, responsible, reliable, sensitive to criticism by others, gentle; self-confident in social situations - ambitious in socially recognized directions; more laudatory than power-oriented - sensory awareness & self-awareness constrained by goal-directed activity & preference to see self in socially desirable terms - self-satisfied, conservative, conventional, avoids change, variety and risk-taking; feels capable of initiating activities and achieving goals - seeks order; uncomfortable with ambiguity, conflict - sees self as creative but more in terms of productivity

TABLE 39 cont.

LEVEL 3

DESCRIPTIVE DIMENSIONS

Cognitive style and cognitive abilities associated with creativity	<ul style="list-style-type: none"> - bidirectional in hemispheric utilization; flexible & integrative in cognitive processing; cognitive style characterized by complexity - facile in logical, analytic, wholistic, divergent, convergent, verbalizing or visualizing styles - information perceived & encoded multidimensionally; emotional, sensory, semantic properties of both consciously attended and peripheral or preconsciously perceived information - high level & range of creative abilities; utilization of abilities in an adaptive manner <u>e.g.</u> complex associative processes encompassing semantic & imaginal aspects, which leads to creative conceptualization such as metaphorical thinking, Janusian thinking, bisociation, synthesis - intuitive thinking characterized by prior lack of awareness, effortless experiencing; incubation may be functional, involving interaction of preconscious & conscious activity with memory encoded information; receptivity to internal states allows recognition of product which may be triggered by situational associative links
Imagery ability and imaginal processing	<ul style="list-style-type: none"> - vivid visual imagery; awareness and utilization of controlled imaginal processes as well as spontaneous, autonomous imagery - image content not restricted to memory; imaginative & constructive - control of imagery applies to all aspects: colour, movement, emotional content - imaging processes are adaptive and integrative in cognition and creative behaviour <u>e.g.</u> autonomous imagery may generate ideas, controlled imagery utilized in development and production of ideas; integrative conceptualization such as Janusian thinking

TABLE 39 cont.

LEVEL 3 cont.

Situational influence and motivation	<ul style="list-style-type: none"> - internal state, emotional involvement & commitment predominates over task and situational characteristics; internally motivated rather than externally; tendency to become emotionally involved is a generalized characteristic - although environmental characteristics may be influential at some phases <u>e.g.</u> in allowing a relaxed, receptive state for enhancing intuitive or imaginal awareness, a facilitative environment is shaped or created rather than passively reacted to - a system of ethics and values is consistent & pervasive, motivating and guiding activity; ideals such as quality, truth are held rather than pragmatic or socially esteemed values
Personality characteristics	<ul style="list-style-type: none"> - accepts and experiences range of emotions; emotional aspects are integral to perception and activity; sensitive, humorous, changeable, somewhat dissatisfied - friendly, considerate, self-confident, dependable; assertive, autonomous, independent; initiators and leaders - determined, persistent, enterprising, active, productive - curious, aesthetically reactive, sensorially & self-aware to a high degree, receptive to internal & external states - expressive, spontaneous, impulsive, adventurous, able to tolerate ambiguity, conflict and disorder; seeks variety, accepts risk - sees self as creative rather than productive

The separation of imagery from cognitive abilities and motivation from personality characteristics does not imply that these are considered independent aspects of creativity, nor are the three levels considered to be self-contained or distinct. In reality it would be difficult to clearly separate the complexity of interacting internal and external processes which are represented here and an individual may be described at different levels for different aspects, either temporarily or continuously. However, the characteristics are conceptualized as clustering together, with an interdependent and contributory dynamicism. It is not a developmental model although development in utilization of abilities is potentially available, as implied with the effect of training in Experiment 3. With this view, development would be limited to Levels 2 and 3, with the prerequisite being capability. Even within this context, movement between levels is probably constrained by individual differences which are typically enduring, such as hemispheric bias and may even be neurologically influenced.

This is not strictly a continuum model, between poles of uncreative and creative. Depending on the criterion of creativity, some may see Level 2 as more creative if the product or productivity is the identifying factor. A noticeable deviation from other models or theories focusing on the creative process or person (e.g. Maslow, 1971; Torrance & Hall, 1980; Ainsworth-Land, 1982) is the absence of a level considered by some to be the acme of creativity, characterized by experiences of cosmic consciousness,

self-actualization, satori, transcendence, mystical visions, from which the truly transformational creative achievements supposedly occur. From the theoretical framework proposed here, this writer is somewhat skeptical as to whether a constellation of person and process characteristics discriminate experiencing of these phenomena as an additional level, and is inclined to view these experiences as just that - transcendent and rare emotional experiences which would occur only at Level 3, associated with intense emotional involvement and experiential openness. Biographical accounts of eminent creators provide the only source of evidence for the phenomena described; these are limited in number, detail and objectivity, leaning more toward the poetic than the psychological.

Similarly, certain cognitive processes associated with Level 3 e.g. intuition, Janusian conceptualization, are not conceived of as elevated or higher order processes as a number of theorists do, who use terms such as supralogical, magical synthesis, further reaches (refer Chapter 1). Rather, a more lateral perspective has been taken, that more creative individuals are open to, utilize and integrate the range of cognitive processes and strategies in an adaptive, expanded manner.

Intellectual level and technical competence have not been included as factors in the formulation of levels of creativity. The model presupposes the requisite intellectual ability and technical proficiency (or the capacity to attain skills) in its focus on characteristics contributing to creative behaviour.

At Level 1, individuals lack the cognitive abilities associated with creativity, or may demonstrate only isolated aspects, and their cognitive style and personality characteristics are antithetic to creative thinking. From the empirical results, at least two fairly distinct types are suggested. With respect to personality style and imaginal processes, these types are distinguished broadly by overcontrol and undercontrol.

Individuals functioning at Level 2 may exhibit creative behaviour and achievements, but inconsistently and usually in a specific mode or context. A verbalizing cognitive style, expressed in superior creative ability in a verbal mode e.g. associative or divergent thinking, than in a figural or visual mode, may be largely due to cultural and educational influences rather than potential ability. The socially conforming personality style of these individuals may contribute to the impact of cultural influence in the development of processing preference. Characteristically self-satisfied, uncomfortable with change and constrained by social convention, creative achievements by persons at this level would be expected to fall within existing paradigms, rather than disrupting them.

At Level 3, individuals not only possess the autonomy, self-direction and self-awareness to free them from these constraints, they feel a degree of dissatisfaction with the existing order, a necessary condition for major breakthroughs. They are able to tolerate ambiguity and disorder and may in fact desire

change, variety, an element of risk. An important distinguishing feature between Level 2 and 3 is the awareness, acceptance and channelling of emotion, which influences all aspects of cognition and performance at the third level. An affective component in perception, encoding and processing of information is hypothesized to lead to associative thinking of a multidimensional nature (e.g. Janusian conceptualization, bisociation), enhance memory retrieval, contribute to intuitive thinking characterized by prior lack of awareness and effortless experiencing and may facilitate associative triggering of preconscious information into conscious awareness. The intense emotional involvement demonstrated at this level, is considered to fuel persistent effort and resistance to premature closure, enabling incubatory effects to occur and the entertaining of alternative, seemingly paradoxical perspectives.

Summary and implications

The model of creativity proposed describes three levels of creative behaviour in terms of cognitive style and creative abilities, visual imagery ability and processing, situational influence and motivation, and personality characteristics. Based on the empirical findings from this thesis, the defining factors are selective in their representation of levels and not plenary. For example, visual imagery is considered the most pervasive mode in creative cognition (discussed in Chapter 2, section (d)) although other modes such as auditory imagery would be relevant in field specific products. Representative factors are also limited by existing theory and operational definitions of aspects of creativity for observational

purposes.

The model is basically descriptive and as such has not ventured into theoretical domains except fleetingly. A range of empirical directions from the present investigation have been suggested throughout the thesis and in this final chapter a multidimensional, interactive conceptualization of levels of creativity proposed. The state of creativity research is believed to be at a point where once again theorizing is required. Original theories served the purpose of stimulating experimental efforts which have subsequently demonstrated these theories to be simplistic and inadequate. Empirical investigation has expanded in focus and perspective in recent years, appropriately to the nature of this area of human behaviour and has led to more substantive models with heuristic merit. The model proposed here differs from previous monistic focuses on person, process or product and is considered an advance in its multidimensional, interactive perspective and the lateral conceptualization of utilization of ability rather than a hierarchical, unitary trait conceptualization. However, the development of theories to guide future research is now exigent, or the ever-increasing accumulation of empirically derived information may lead us further away from an explanatory goal rather than towards it.

From the present model, three aspects are seen to have particularly important theoretical implications.

(1) The interrelationship of cognitive style, hemispheric bias and personality characteristics has major importance

for a developmental theory of creative endeavour. Significant components of a developmental theory would be: Lateralization of positive and negative emotions, lateralization and hemispheric facilitation of cognitive processing, degree of voluntary allocation of processing, situational influences on processing strategy vs. recurrent cognitive strategies.

(2) An adequate theory of preconscious processing would need to incorporate multidimensional encoding, receptivity to unattended information, nature of effortless experiencing and triggers to spontaneous problem solutions. A related issue in a theory of preconscious involvement would be an aspect of creativity which has received little attention as yet. The selection of a problem, a direction of pursuit and a solution which is qualitatively the most parsimonious, elegant and adaptive from possible alternatives, appears to occur often without a conscious decision-making process or even an awareness at the time of alternatives (e.g. Poincare 1924). One hypothesis arising from the literature on creative personalities and from current findings (e.g. predictive utility of BDS Person subscale for more creative subjects), is that the adherence to personal values and ideals, which creative individuals demonstrate, guides this selection process. Their sense of quality may be so integral as to be automatic, operating at a preconscious level.

(3) Rather than focusing solely on the possession of creative abilities, utilization of these and facilitating influences, theoretical constructions should also involve

interfering conditions and constraints on utilization of abilities. This perspective predominated in early psychoanalytic theories and its absence in empirical work may have been due to this paradigmatic affiliation. The development of appropriate training procedures relies on this alternative perspective in theory.

Perhaps we are now approaching the point of beginning.

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APPENDIX 1

COMPUTER PROGRAM FOR 'RAPID OPPOSITE RESPONDING' TENDENCY
MEASUREMENT IN WORD ASSOCIATION TASK (JANUSIAN THINKING)

```

5 N1%=100%
10 S7=1
15 S=.5
20 Z=1
25 DIM E(100),C2(100)
30 DIM C(100),L(100),R(100)
35 DIM C1(4),S(4),S2(4),H(4),S1(4)
40 PRINT "INPUT SUBJECT NUMBER = " \ INPUT J#
45 S3#="SUBJ. # = "
50 OPEN "SUB.DAT" FOR INPUT AS FILE #4
55 INPUT #4,S7
60 CLOSE #4
65 OPEN "CARBET" AS FILE #2
70 PRINT "DO YOU REQUIRE A STATS. TEST ? (Y) OR (N) "
75 INPUT T# \ IF T#="Y" THEN 85
80 IF T#="N" THEN 125 \ IF T#=" " THEN 125
85 PRINT "INPUT STATS. DATA"
90 PRINT "NOTE - CHANGE N1 AT TOP OF LIST IF NECESSARY"
95 S7=S7-1
100 FOR J1%=1% TO 10%
105 N1%=10%
110 INPUT H#
115 R(J1%)=H#
120 NEXT J1%
125 IF V%=1% THEN RESP(V%)
130 FOR J2%=1% TO N1%
134 OUT8(1%,0%,32677%)
135 FOR P=1 TO 6 \ PRINT " " \ NEXT P
140 IF T#="Y" THEN 210
145 INPUT #2,A#
150 IF A#="." THEN 400
155 FOR T=1 TO 100*S \ NEXT T
160 PRINT TAB(35);A#
165 FOR H=1 TO 6 \ PRINT " "
170 NEXT H
172 C%=0%
173 R0%=0%
175 SCLK
180 FOR T=1 TO 100*S \ NEXT T
185 PRINT "VOX"
187 IF R0%>2% THEN RESP(C%)
188 IF R0%>2% THEN RCLK(T%)
189 IF C%=1% THEN IF T%>350 THEN 390
191 RESP(V%)
192 RCLK(T%)
200 R0%=R0%+1%
209 IF C%=0% THEN R0%=1%
210 PRINT "CAT. "

```

```

215 RESP(C%)
216 R0X=R0X+1%
217 IF C%=2% THEN 390
218 IF C%=1% THEN 187
225 IF R0X<3% THEN 265
230 GO TO 275
240 RESP(C%)
245 R0X=0%
250 E=0
255 GO TO 275
260 RCLK(EM) \ IF EX<350 THEN 187
265 IF TX<25 THEN 335
270 IF TX>350 THEN 335
272 IF C%=2% THEN 390
275 IF C%<4% THEN 360
280 IF C%>7% THEN 360
285 IF (C%)=4% THEN C(J%)=C%
290 IF (C%)=5% THEN C(J%)=C%
295 IF (C%)=6% THEN C(J%)=C%
300 IF (C%)=7% THEN C(J%)=C%
305 IF TX>25 THEN 320
310 E(J%)=TX
315 IF TX=0 THEN C(J%)=0 \ IF TX=0 THEN GO TO 335
320 R(J%)=TX/50
325 L(J%)=LOG10(TX/50)
330 GO TO 390
335 PRINT "T1. ERR. "
340 E(J%)=TX \ C2(J%)=V%
345 REM ERROR STORE AT E(J%),AND C2(J%)FOR CATEGORY.
350 C9%=N1%-1%
352 R0X=0%
355 GO TO 390
360 E=E+1 \ OUTB(1%,1%,1%)
375 R0X=0%
380 IF E=1 THEN 240
385 STOP
390 NEXT J%
395 FOR Y=1 TO 6 \ PRINT " " \ NEXT Y
400 PRINT "END OF DATA"
405 CLOSE #2
410 FOR I%=1% TO 4%
415 C1(I%)=0
420 S(I%)=0
425 S2(I%)=0
430 C(J1%)=C%
435 FOR J1%=1% TO N1%
440 IF C(J1%)=(I%+3%) THEN 450
445 GO TO 470

```

```

450 C1(I%)=C1(I%)+1%
455 REM PRINT R(J1%);C1(I%)
460 S(I%)=S(I%)+R(J1%)
465 S2(I%)=S2(I%)+R(J1%)^2%
470 NEXT J1%
475 IF C1(I%)<1 THEN 510
480 M(I%)=S(I%)/C1(I%)
485 IF M(I%)=0 THEN 510
490 IF C1(I%)=1 THEN S2(I%)=0
495 IF S2(I%)=0 THEN 510
500 S2(I%)=SQR((S2(I%)-S(I%)^2%/C1(I%))/(C1(I%)-1%))
505 REM PRINT M(I%);S2(I%);S(I%);C1(I%);I%
510 NEXT I%
515 C9%=C1(1%)+C1(2%)+C1(3%)+C1(4%)
520 S7=S7+1
525 PRINT "RESULT SUMMARY PRINTED, (Y) OR (N)" \ INPUT P$
530 IF P$="Y" THEN 550
535 IF P$=" " THEN 640
540 IF P$="N" THEN 640
545 IF P$<>"N" THEN 525
550 OPEN "LP:" FOR OUTPUT AS FILE #1
555 PRINT #1," " \ PRINT #1," " \ PRINT #1," "
560 T$="### ##"
565 PRINT #1,USING T$;S7;
566 PRINT #1,USING J$
575 FOR I%=1% TO 4%
578 A$="# ### ##.### #.### #.###"
580 PRINT #1,USING A$;I%+3%;C1(I%);C1(I%)/C9%*100;M(I%);S2(I%)
590 NEXT I%
595 IF Z=0 THEN 630
600 PRINT #1," " \ PRINT #1," "
605 PRINT #1,TAB(8);"REACTION TIME";TAB(32);"CATEGORY";TAB(48);"WORD"
610 PRINT #1;"SECONDS";TAB(16);"LOG10 SECS."
615 FOR P%=1% TO N1%
620 PRINT #1,R(P%);TAB(16);L(P%);TAB(32);C(P%);TAB(48);P%
625 NEXT P%
630 CLOSE #1
635 IF Z=0 THEN 880
640 OPEN "NAME.DAT" AS FILE #6
645 PRINT "DATA FILE NAME = ";
650 IF S7=1 THEN 660
655 FOR N5=1 TO S7-1 \ INPUT #6,R$ \ NEXT N5
660 INPUT #6,R$
665 IF R$="ZZZZ" THEN PRINT "END OF NAME FILE, ";R$
670 CLOSE #6
675 PRINT TAB(20);R$
705 OPEN R$ FOR OUTPUT AS FILE #3
710 PRINT #3,USING "###",S7

```

```

712 PRINT #3,J$
715 FOR IZ=1% TO 4%
720 PRINT #3,USING "#", IZ+3%
721 PRINT #3,USING "###", C1(IZ)
722 PRINT #3,USING "##.####", C1(IZ)/C9%*100
723 PRINT #3,USING "#.####", M(IZ)
724 PRINT #3,USING "#.####", S2(IZ)
730 NEXT IZ
745 FOR PZ=1% TO N1%
750 PRINT #3,USING "#.##", R(PZ)
751 PRINT #3,USING "#.####", L(PZ)
752 PRINT #3,USING "#", C(PZ)
753 PRINT #3,USING "###", PZ
755 NEXT PZ
756 CLOSE #3
760 OPEN "SUB.DAT" FOR OUTPUT AS FILE #4
770 PRINT #4,S7
775 CLOSE #4
780 IF P$="Y" THEN 875
785 PRINT " " \ PRINT " " \ PRINT " "
790 PRINT "*****"
795 PRINT "TRIAL= ",S7;TAB(15);"FILE NAME = ";R$;TAB(35);S3$;J$
800 PRINT "*****"
805 FOR IZ=1% TO 4%
810 PRINT "CAT. ="; IZ+3%;TAB(9);"TOT. OBS. ="; C1(IZ);TAB(24);"% OBS. = ";
815 PRINT C1(IZ)/C9%*100;TAB(43);"MEAN ="; M(IZ);TAB(59);"S DEV ="; S2(IZ)
820 NEXT IZ
825 PRINT " "
830 FOR K=1 TO 1000 \ K1=K1+1 \ K1=K1-1 \ NEXT K
835 PRINT TAB(8);"REACTION TIME";TAB(32);"CATEGORY";TAB(48);"WORD"
840 PRINT "SECONDS";TAB(16);"LOG10 SECS. "
845 FOR PZ=1% TO N1%
850 PRINT R(PZ);TAB(16);L(PZ);TAB(32);C(PZ);TAB(48);PZ
855 NEXT PZ
860 FOR PZ=1% TO N1%
865 PRINT E(PZ);C2(PZ);PZ
870 NEXT PZ
875 Z=0 \ GO TO 550
880 END

```

APPENDIX 2

DESCRIPTIONS OF CRITERION-REFERENCED MEASURES FOR FIGURAL
FORM OF TTCT FROM TORRANCE (1979); TORRANCE & BALL (1980)

1. Expression of feeling and emotions. This is considered an index of at least certain facets of emotional awareness. It is scored positively for expression of feelings and emotions in the titles of the drawings and the drawings themselves. Examples of verbal cues in the titles or speech of the figures are: sad, happy, joy, love, anger, hate, mean, scared, lost. Examples of nonverbal cues in the drawings include: facial expressions, especially mouth position; gestures with hands, body posture.
2. Articulateness in telling a story; giving context. Communication of creative ideas is considered to require sufficient detail as well as some action or environmental context that makes the idea meaningful to the other person. This ability is scored for when some kind of environmental context is added to the figural tasks. Examples are interactions between two persons, two animals, two objects etc. in an identifiable environmental setting.
3. Movement and action. The inclusion of this measure is based on Torrance's observations and theories of projective psychology e.g. perception of movement in Rorschach Ink Blots has been considered an indicator of imagination. Indications of movement and action are obtained from titles, speech of figures and bodily posture of figures e.g. running, flying, reaching

upward.

4. Expressiveness of titles. This measure is an attempt to get at another aspect of the ability to abstract and express emotion and feeling. To be scored for this, a title must go beyond simple description and communicate a feeling, emotion or other synthesis.
5. Combination of two or more incomplete figures. This occurs rarely in Torrance's experience. It is a synthesis, representing an ability to see relationships among rather diverse and otherwise unrelated elements.
6. Combination of two or more sets of lines. Again, this is a measure of the tendency to synthesize and is considered to be an important indicator of a creative disposition. Under restrictive conditions (test instructions and format of booklet) the creative person sees possibilities that others assume have been closed.
7. Unusual visual perspective. The tendency to present ideas or objects in unusual visual perspective seems to be an especially important indicator of creative potentiality, according to Torrance. Perceiving things in new and unusual ways is scored from visual perspectives in the drawings other than the common static, upright, "straight on" view e.g. underneath.
8. Internal visualization: perception of things seen inside. There are many indications that creative people are able to visualize beyond exteriors and pay attention to the internal dynamic workings of things (Torrance, 1979). Examples which would be scored positively for this are: the peas inside a pod, the contents of a garbage can, an embryo inside a pregnant mother.
9. Humour in titles, captions and drawings.

(Self-explanatory).

10. Richness of imagery. Responses are scored for richness of imagery when they show variety, vividness, liveliness and intensity. It's not necessary that the images be original but they do have to get away from the most obvious and commonplace and create strong, sharp, distinct pictures in mind of beholder.
11. Colourfulness of imagery. Some responses may be both rich and colourful, while others may be colourful without being rich or the reverse. Colourfulness is defined as exciting in the appeal to the senses of taste, touch, smell, feel, sight etc. Other synonyms might be: flavour, earthiness, unreal, spooky, emotionally appealing, fantastic. Examples of colourful responses are: angel, ghost, devil, mythical figures.
12. Breaking, extending boundaries. The creative solution of many problems involves redefinitions, getting out of the rut of unsuccessful solutions of the past - breaking or extending the boundaries of the problem as currently defined. In the drawings, this is scored for if the pictures from the parallel lines extend beyond the boundaries of the imaginary rectangles described. The rectangle may be split and each line used as the basis for two or more elements in a picture. Or, the lines themselves may be extended in a variety of ways.
13. Fantasy. Scored for fantasy images in the drawings such as Mother Goose characters, fairy tale episodes, characters from fables, myths or science fiction.

APPENDIX 3

WORK ENVIRONMENT DESCRIPTION SCALE

This questionnaire contains a series of statements which can be used to describe a work environments. Please rate the degree to which each statement applies to your work situation by assigning a number between 1 and 10. The scale below demonstrates what a rating of 1 or 10 would mean. These are the upper and lower limits, but you may find a rating in between more applicable to your situation. Remember, this is how you see the situation.

1	2	3	4	5	6	7	8	9	10
1 - very little or none at all							very much, - 10 most important aspect		

- | | <u>RATING</u>
1 - 10 |
|---|-------------------------|
| a. How committed and enthusiastic are you about your job? | () |
| b. Rate the degree of friendship and communication among your fellow workers. | () |
| c. Rate the degree of staff support in your job. | () |
| d. How much stress is placed on 'getting the job done' before any other considerations? | () |
| e. How competitive is your work situation? | () |
| f. How much pressure do you feel in your job to meet deadlines, finish work in certain time limits? | () |
| g. To what degree do you know what is expected of you in your job, how clearly are rules and policies communicated? | () |
| h. What degree of responsibility is attached to your job? | () |
| i. How much independence do you have in your work situation? | () |
| j. To what degree are new ideas and changes accepted and put into effect in your workplace? | () |
| k. How pleasant and comfortable are your work surroundings? | () |

APPENDIX 4

HOME ENVIRONMENT DESCRIPTION SCALE

This questionnaire contains a series of statements which can be used to describe a home environment. Please rate the degree to which each statement applies to your home/family situation by assigning a number between 1 and 10. The scale below demonstrates what a rating of 1 or 10 would mean. These are the upper and lower limits, but you may find a rating in between more applicable to your situation. Remember, this is how you see the situation.

1	2	3	4	5	6	7	8	9	10	
<u>1</u>	-	this	isn't	at	all		this	is	extremely	- <u>10</u>
		important	in	my	home		important	in	my	home,
	-	this	never	happens			this	happens	all	the
		in	my	home			time	in	my	home

- RATING
1 - 10

a. How frequently do your family or household (flatmates) participate in activities together? ()

b. Rate the amount of spontaneous communication between members of your household. ()

c. What is the degree of conflict in your home (arguments, antagonism, disruptive behaviour etc.). ()

d. Does your household make decisions as a group, rely on each other? ()

e. Rate the degree to which the members in your household are self-sufficient. ()

f. How important is achieving, or winning in what you undertake, in your home (e.g. school, sport, work)? ()

g. How frequent are discussions about political, social and cultural issues in your family? ()

h. How important are recreational activities and leisure time in your household? ()

i. How important are religious or ethical issues and moral values in your family? ()

j. To what degree are family and household activities or time organized? ()

k. To what extent are rules and firm discipline used with your family? ()

APPENDIX 5

DESCRIPTION OF ADJECTIVE CHECKLIST SCALES:

PERSONALITY CORRELATES (GOUGH & HEILBRUN, 1980)

1. Number Checked : No. Ckd
2. Number of favorable adjectives checked : Fav
3. Number of unfavorable adjectives checked : Unfav
4. Communality : Com
5. Achievement : Ach
6. Dominance : Dom
7. Endurance : End
8. Order : Ord
9. Intraception : Int
10. Autonomy : Aut
11. Change : Cha
12. Self-Confidence : S-Cfd
13. Personal Adjustment : P-Adj
14. Creative Personality Scales : Cps
15. High Origence, Low Intellectance : A-1
16. High Origence, High Intellectance : A-2
17. Low Origence, Low Intellectance : A-3
18. Low Origence, High Intellectance : A-4

1. Total number of adjectives checked: No. Ckd

High-scorers on No. Ckd appear to be expressive individuals, eager to explore the world around them but somewhat inconstant and even capricious in their reactions. The high-scorer seems to be an attractive person, vivacious and quickly enthusiastic, but at the same time somewhat self-seeking and lacking in responsibility. Low-scorers on No. Ckd are less urgent, narrower in interests, more reserved and conventional, and less likely to behave impulsively or erratically. The ego ideal of the low-scorer sets standards of moderation, sobriety, and good judgement. That of the high-scorer values versatility, spontaneity, and the enhancement of self in action.

2. Number of favorable adjectives checked: Fav

High-scorers are seen as adaptable, outgoing individuals, protective of those close to them, cheerful in the face of adversity, and productive as workers. The desirability of their self-descriptions, in other words, is not a fraud or deception; on the contrary, high-scorers on Fav appear to be quite justified in ascribing these favorable items to themselves.

There appear to be two kinds of respondents who get low scores on Fav. The first is dispirited, self denying, fearful of the future, and easily subdued by the vicissitudes of life. The second, less numerous, is more skeptical, counter-active in style, sharp-tongued, and quick to discern and point out incongruities, flaws, and blameworthy shortcomings in the behavior of others. Less favorable self-description in the former case reflects an authentic self-evaluation as deficient in socially desirable attributes. In the latter, unfavorable self-description

bespeaks a defiant rejection of the restrictive niceties of convention.

3. Number of unfavorable adjectives checked: Unfav

The high-scorer on Unfav may be characterized as a disbeliever, pessimistic about the future, changeable, headstrong, and quick to take offense or umbrage. The good fortune or success of others is seen as unearned and unfair. Self-doubt and self-rejection lead to feelings of bitterness and hostility toward others. The low-scorer on Unfav is more dependable, more tactful, less judgemental, and less easily offended.

4. Communality: Com

The high-scorer on Com appears to be a reliable person, considerate of others, free of pretense, and comfortable in interpersonal relationships. The low-scorer is ambivalent in relating to others, may express opposition in deviant ways, tends to be contentious and defensive, and finds it difficult to conform to the everyday expectations of interpersonal life.

5. Achievement: Ach

The high-scorer on Ach is a hard-working, goal-directed individual, who is determined to do well and usually does. The motivation to succeed seems to lie less in competitive drives than in an insistent need to live up to high and socially commendable criteria of performance. Others acknowledge the energy and enterprise displayed by the high-scorer, but also see elements of coercion, impatience, and self aggrandizement. The low-scorer is less effective, less venturesome, and less persistent, but at the same time an easier and more congenial companion whose diffidence has a certain charm.

6. Dominance: Dom

The high-scorer on Dominance is a strong-willed, ambitious, determined, and forceful individual, free of self-doubt in the pursuit of goals, and little if at all inhibited by the disapproval or opposition of others. The high-scorer is affiliative and adroit in directing the group's actions toward the attainment of socially worthy objectives. The low-scorer lacks confidence, prefers to be on the periphery of group enterprise, and shuns situations calling for competition or the assertion of self.

7. Endurance: End

High-scorers on End have a strong sense of duty, work conscientiously, and eschew frivolity and the nonessential. Conservation of the tried and true is deemed more important than the discovery of the new and different. Low-scorers are changeable, easily distracted or redirected, leisurely, and informal individuals who take pleasure in new experiences and the endless variety of everyday life.

8. Order: Ord

The high-scorer on Ord seeks objectivity and rationality, is firm in controlling impulse, and unswerving in the pursuit of goals. Setbacks and distractions are not easily endured, nor are change and variety welcomed. The low-scorer is less inhibited and more expressive, but at the same time less able to persevere in a steady pace of work toward a distant goal. The high-scorer prefers tasks demanding self-discipline and diligent effort; the low-scorer, wanting quicker gratification, takes pleasure in the here and now.

9. Intraception

There is a cognitive element that should be noted in

the summary for the Intraception scale, as might be anticipated from its intention. High-scorers are seen as logical and foresighted, and as valuing intellectual and cognitive matters. Low-scorers appear to have a narrower range of interests, to be somewhat superstitious, and to be less capable in coping with stress or trauma. High-scorers tend to be complex and internally differentiated, whereas low-scorers tend to be simple and prosaic.

10. Autonomy: Aut

Those who score high on Aut are independent and autonomous, but also assertive and self-willed. They tend to be indifferent to the feelings of others, and are viewed as egotistical and headstrong. Low-scorers are more conventional, seek security in the tried and true, avoid risks, and welcome direction from trusted superiors.

11. Change: Cha

Taking pleasure in change and variety, persons high on Cha are typically perceptive, spontaneous, and aesthetically-minded. They comprehend problems and situations rapidly and incisively, and they have confidence in themselves and welcome the challenges found in disorder and complexity. The low-scorer seeks stability and continuity in the environment, avoids ill-defined and risky situations, and tends to lack verve and imagination.

12. Self-Confidence: S-Cfd

The high-scorers on S-Cfd are initiators, confident of their ability to achieve goals. They are not above cutting a few corners to create a good impression, and observers do see them as assertive, enterprising, and self-confident. The low-scorers have difficulty in mobilizing their resources and taking action; others view

them as shy, inhibited, and withdrawn.

13. Personal Adjustment: P-Adj

The high-scorer on P-Adj has a positive attitude toward life, enjoys the company of others, and feels capable of initiating activities and carrying them through to conclusion. High-scorers may not possess psychodynamic self-understanding, but they do appear to possess the ability to "love and work", proposed by Freud as the critical criteria of personal adjustment. Low-scorers are anxious, high-strung, and moody, avoid close relationships with others, and worry about their ability to deal with the stresses and strains of their lives. Others see them as defensive, preoccupied, and easily distracted.

14. Creativity Personality Scale: Cps

The high-scorer on Cps is venturesome, aesthetically reactive, clever, and quick to respond. Intellectual characteristics such as breadth of interests, cognitive ability, and ideational fluency are also apparent. The low-scorer is more subdued, less expressive, more conservative, and less inclined to take action in complex or ill-defined situations.

15. High Origence, Low Intellectence: A-1

High-scorers on A-1 possess strong instincts, a taste for merrymaking, and easy distractibility. Low-scorers are prudent, vigilant, and programmed; they plan ahead and avoid intemperance and the undue expression of impulse. High-scorers are more easygoing and accepting of both self and others, whereas low-scorers take a firm stand on ethical issues and look askance at those who violate society's conventions.

16. High Origence, High Intellectence: A-2

The high-scorer on A-2 is self-sufficient, strong-willed, original in thought and perceptions, aesthetically sensitive, indifferent to convention, and much annoyed by those who are uninsightful, intellectually maladroit, or lacking in perspicacity. In spite of many talents, the high-scorer on A-2 is scarcely more comfortable with his or her own inner needs and reactions than with those of other people. Intimacy based on the candid sharing of emotionally significant feelings is sensed as dangerous and hence avoided. The low-scorer is a more mundane, practical, ordinary individual, less temperamental, more predictable, and less apt to lash out at others for their ineptitude and intellectual blunders.

17. Low Origence, Low Intellectence: A-3

The high-scorer on A-3 is an unpretentious, uncomplicated, forbearing individual, protective of close friends, forthright, rule-respecting, and content with his or her role and station in life. The low-scorer is intelligent and inventive, but at the same time anxious, ill at ease, worrying, and preoccupied; keeping people at a distance, the low-scorer is skeptical about their intentions and tends to feel alienated.

18. Low Origence, High Intellectence: A-4

The high-scorer on A-4 is analytic, logical, astute, intellectually capable and self-disciplined, and fully prepared to undertake the planning and hard work necessary for the attainment of rationally established goals. The low-scorer is less controlled, more changeable, and more easily influenced by illogical concerns. Whereas the high scorer finds it hard to unbend and give in to whim and impulse, the low-scorer delights in informality and letting go.

APPENDIX 6

DIFFERENCES BETWEEN ACADEMIC STAFF AND
TECHNICAL/SECRETARIAL STAFF

1. Self-concept

The degree of association (X^2) between staff grouping and self-concept group approached significance ($p = .06$). The majority of academics classified themselves as creative/productive (60%) while the technical/secretarial group tended to evaluate themselves as either creative/productive (47.1%) or uncreative/productive (41.2%).

2. Creativity scales

Academics scored significantly higher on Taylor's BDS subscales of Problems ($p = .03$) Emergentive, ($p = .03$) and approaching significance for Inventive ($p = .07$). They also scored significantly higher on CPS ($p = .002$) and the Holmes questionnaire ($p = .001$).

3. TTCT performance

Analyses of variance, adjusted for effects of order, and instructions resulted in significant differences, with academics superior, on: Figural fluency ($p = .02$), Figural originality ($p = .009$), Unusual visual perspective ($p = .02$) in the home and combination repeated figures ($p = .02$), Fantasy ($p = .01$) at work.

Although other differences were not statistically significant, academics performed consistently better on all divergent thinking tasks, verbal and figural, in both environments. However there was considerable overlap. On the criterion measures of figural performance there tended

to be no difference between groups and on some measures the technical/secretarial group obtained higher scores.

A stepwise discriminant analysis was performed which included demographic information and cognitive style variables. The function derived correctly classified 100% of the sample in terms of 5 variables (Canonical correlation = .98, $p = .000$). Academics were identified on the dimension by higher education and more vivid visual imagery predominantly. In order of importance, Information access to interpersonal sources, Rapid opposite responding and Age accounted for the remaining discriminatory power of the function.

In summary, in comparison with the technical/secretarial group the academic staff were identified by a range of measures, as more creative and more accurately evaluated themselves in terms of creativity.

APPENDIX 7

CREATIVITY TRAINING PROGRAM OUTLINE

SESSION 1: Problem definition, problem generation

- exercises.

SESSION 2: Functional fixedness

- increasing fluency of ideation by withholding judgement.

SESSION 3: Brainstorming-principles

- small group exercises - brainstorming a problem, evaluation of ideas, selection and improvement
- forced verbal associations for generating new ideas.

SESSION 4: Evaluating ideas - determining and developing criteria, deferring judgement, rating ideas in terms of criteria.

SESSION 5: Observation and fact-finding - intensification of observation, new perspectives, new functions exercises - morphological analysis

- attribute listing.

SESSION 6: Altering, modifying existing idea, object or product e.g. Put to other uses? Adapt? Modify? Magnify? Minify? Substitute? Rearrange? Reverse? Combine?

SESSION 7: Continuation of 6, exercises.

SESSION 8: Mechanical design exercises using all previous concepts and techniques.

APPENDIX 8

VISUAL IMAGERY TRAINING PROGRAM OUTLINE

SESSION 1: Introduction - explanation of visual imagery, dimensions of

- goals of training program to increase awareness and utilization of visual imagery
- exercise to increase receptivity to spontaneous imagery evoked by selections of music, poems.

SESSION 2: Perceptual awareness - observation, noticing, focusing on parts and whole of visual displays

- manipulating observations to create new ideas
- exercises with visual illusions, ambiguous figures, figure/ground reversals.

SESSION 3: Perceptual disembedding - breaking up an organized visual field

- exercises with embedded figures

SESSION 4: Spatial Manipulation - rotations, Minnesota Paper Form Board

- visualizing different perspectives, internal visualization, visualizing movement - alternation between perception of concrete object and visual image.

SESSION 5: Visual Associations - restructuring exercise with geometric pieces

- forcing visual relationships to facilitate new perspective or idea
- visual metaphors

SESSION 6: Recognizing attributes through visualization,

imaging flexibility, fluency.

SESSION 7: Visualizing abstract concepts

- alternation between imagery and verbal concepts in design

- exercise: design a squirrel chasing machine - separate imagery for each criterion moving to synthesis

SESSION 8: Imagery and Memory-mnemonics,

interactive images, word associations.

APPENDIX 9

CRITERIA FOR RATING MACHINES ASSIGNMENT
ENGINE FORCE ANALYSES

Student _____

Visual Imagery

- | | | | |
|---|---|---|---|
| 1. Can student visualise original system? How well has s/he sketched the system? | 0 | 1 | 2 |
| 2. Has student modelled the original system correctly? Has s/he produced correct free body diagrams, applied Newton's Laws, force and balance equations, stated constraints, correctly? | 0 | 1 | 2 |
| 3. Can student visualise motion? Has s/he correctly sketched directions and relative magnitudes of velocities and accelerations of various parts of system? | 0 | 1 | 2 |
| 4. Can student visualise action of forces in original system? Has s/he correctly sketched direction and magnitude of forces and position of journal? | 0 | 1 | 2 |
| 5. Can student visualise new system? | 0 | 1 | 2 |
| 6. Has student modelled new system correctly? | 0 | 1 | 2 |
| 7. Can student visualise action of forces in new system? Has s/he correctly sketched direction, magnitude and action of forces? | 0 | 1 | 2 |

Creativity

- | | | | |
|--|---|---|---|
| 1. Can student synthesise a new system by interrelating fbd's - geometrically, kinematically and in relation to force and moment transmission? Does s/he show originality in analyses? | 0 | 1 | 2 |
| 2. Does student show originality in sketches of system, motion, action of forces, etc.? | 0 | 1 | 2 |
| 3. Can student correctly explain difference in results i.e. polar plots and torque diagrams, from original and new systems? | 0 | 1 | 2 |
| 4. Can student correctly explain the relative importance or contribution of various system parameters to outcome? | 0 | 1 | 2 |

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